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ABSTRACT

This publication is one of the tangible responses of the African Social and Environmental Studies Programme (ASESP) to the challenges of sustainable development which were presented to the world by the United Nations Conference on Environment and Development (UNCED). It seeks to increase the chances of attaining sustainable development by building capacity for it through environmental education. This content and methods book aims to enhance the knowledge and pedagogical competencies of teachers, student teachers, and tutors to effectively deal with environmental education learning and training. The ten chapters in this book are practical and action-oriented and contain assignments and activities necessary for effective learning, teaching, and training in environmental education. Chapters include: (1) "The Environment: What It Is"; (2) "Environmental Education in Perspective"; (3) "What is Known About Learning, Remembering, and Effective Teaching When Applied to Environmental Education"; (4) "Environmental Issues and Problems"; (5) "Methods, Techniques, and Strategies for Teaching Environmental Education"; (6) "Applying Methods, Techniques, and Strategies to Environmental Education"; (7) "Teaching and Learning Resources"; (8) "Classroom Evaluation of Environmental Education"; (9) "Natural Resources"; and (10) "Technology and the Environment". (JRH)

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ENVIRONMENTAL EDUCATION FOR SUSTAINABLE DEVELOPMENT FOR PRIMARY SCHOOL TEACHERS AND TEACHER EDUCATORS IN AFRICA

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ENVIRONMENTAL EDUCATION FOR SUSTAINABLE DEVELOPMENT FOR PRIMARY SCHOOL TEACHERS AND TEACHER EDUCATORS IN AFRICA

Edited by
Peter Muyanda-Mutebi
and
Martin Yiga-Matovu

THE ASESP SECRETARIAT

NAIROBI, KENYA.

Environmental Education for Sustainable Development for Primary School Teachers and Teacher Educators in Africa

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I. A Baseline Survey of Environmental Education in Botswana, Kenya and Sierra Leone and the Research Findings Seminar.

II. The Training and Writers' Workshop in Environmental Education for Sustainable Development.

III. Editing and Publishing the First Edition of this book, **Environmental Education for Sustainable Development for Primary School Teachers and Teacher Educators in Africa.**

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Mr. Stephen N. Iroha

Sierra Leone: Mr. Akie Wilson

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Botswana: Mr. Mokgweetsi Masisi
Nigeria: Dr. C.O. Kupolati
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ASESP would like, nevertheless, to state that, while sharing the credit for this book with all these and other persons and organizations, any errors and discrepancies noted in it are entirely ours.

Peter Muyanda-Mutebi
and
Martin Yiga-Matovu

INTRODUCTION

The last two decades have witnessed an increasingly growing concern about the quality of the environment and its relationship to development. This concern has been manifested in various ways at the local, national, regional and international levels.

At the global level, perhaps the latest most momentous such manifestation was the **United Nations Conference on Environment and Development (UNCED)**, popularly known as the **Earth Summit**, which took place in Rio de Janeiro, Brazil, in June, 1992. At this Summit, more than a hundred heads of government adopted five main documents. Two of these are of immediate relevance to this publication.

The first of these documents, the **Rio Declaration on Environment and Development,** contains fundamental principles which provide various countries with a basis for their future decisions and policies in the context of the environmental implications of socio-economic development.

The second major document is **Agenda 21.** Essentially this is a comprehensive programme for the 21st Century which the 179 states that attended the **Earth Summit** agreed on by consensus. It is a blueprint for a global partnership that aims at attaining sustainable development for all the peoples of the world. Such development would ensure that concerns of economic development, social progress and a safe environment are addressed from a more integrated approach.

A very important facet to this integrated approach advocated most especially by Agenda 21, is the strong emphasis it lays on the crucial role of education in the formation of sustainable development. For, the people's level of knowledge, attitudes, values and practices are critical to the very state of the environment.

This publication is one of the tangible responses of the African Social and Environmental Studies Programme (ASESP) to the challenges of sustainable development which were thrown to the world by the UNCED in its two major documents. It seeks to increase the chances of attaining sustainable development by building capacity for it through Environmental Education. It is a content and methods book which aims at enhancing the knowledge and pedagogical competences of teachers, student teachers and tutors to effectively deal with environmental education learning and training.

All the ten chapters in the book are practical and action oriented. They contain assignments and activitities which should be diligently attended to by the users of the book. We consider this approach to be a crucial necessity for effective learning, teaching and training in Environmental Education.

Lastly, ASESP will be grateful to all who can send criticisms and suggestions for improving this book. This will ensure a better second edition, which is planned for early 1995.

Peter Muyanda-Mutebi
and
Martin Yiga-Matovu

CHAPTER ONE

ENVIRONMENT: WHAT IT IS

Introduction

Living things depend on the environment for such basic necessities as shelter, air, heat, water and food. This is why we need to study about the environment. In this chapter, you are going to learn about the different components of the environment, how they are inter-related, and how they can be sustained. The chapter also operationally discusses the concepts of environment, environmental interdependence, and sustainable development. It ends with two sample lessons which highlight a sample of methods, strategies and techniques which you might utilize to teach and evaluate environmental learning.

Objectives

By the end of this chapter you should be able to:

1. Define the term environment.
2. Identify and describe the different components of the environment.
3. Define the concept of ecosystem.
4. Explain the relationship among the components of the environment.
5. Explain the concept of environmental sustainability.
6. Identify teaching activities which could be used in environmental education
7. Use appropriate evaluation techniques.

Definition

The term "environment" comes from a French word "environmer" which means "surround". Environment then means the surrounding conditions which influence behaviour and development of living things. It relates to such surroundings as land, water, hills, air, climate, materials, cultural practices, work, buildings and anything else that surrounds a living thing.

Components of the Environment

There is no one common way of dividing the environment. How one goes about this division depends on the features that one considers to be central. For example, if *life* is central, then we can divide the environment into the *living* and the *non-living* components. On the other hand, if human activities are considered to be central, then we can divide the environment into the *natural* and the *cultural*, or *man-made*, components. Several other considerations can be used as important criteria for categorizing the main components of the environment.

Let us, in a practical way, help the learners to better understand all this by making them classify the components of the environment around their schools or homes.

Activity 1.A: Simple Classification of Components of the Environment (For ages 7-10)

TEACHER'S ACTIVITY	**LEARNERS' ACTIVITY**
Step 1 (To be conducted outdoors) ◆ **Divide the class into groups of 5-8 learners** ◆ **Ask each learner to list twenty different items around the school compound** ◆ **Have each group prepare a common list in which no item is repeated.**	**Prepare individual lists of twenty items** **Prepare common groups' lists**
Step 2 (In the classroom) ◆ **Instruct the groups to put together on separate lists all the items which they think share common characteristics**	**Compile sub-lists of items with common characteristics**
Step 3 ◆ **Have the learners state the characteristics which they considered to be important bases for their classification.** **Tell the respective groups to use the characteristics they have just named as the headings for the sub-lists**	**Name the chacteristics used in compiling their sub-lists.** **Provide sub-lists with appropriate headings**
Step 4	**At this point, the groups may share their experiences by explaining to the whole class how they developed their sub-lists. Later on, charts may be prepared and displayed in the classroom**

Activity 1.B: Detailed Classification (for ages over 10)

Although this activity is more suitable for older children and student teachers, younger children who have just completed activity 1.A may be able to understand and learn from it. The older children may use it as an extended version of activity 1.A.

Step 1

Display the chart below on a manilla card or on a flat chart, or draw it on the chalkboard. Ask your class to study it, noting that boxes 1 to 5 have no information on them. The test before the class is to identify the missing information for each box on Cards A to E.

Now divide the class into five groups. Each group is given one of the Cards A to E.

Step 2

Instruct the class to identify which of the boxes 1 to 5 their respective card belongs to. Each group is to attempt to answer the questions on its card through discussion. Encourage learners to squarely deal with the question "why/why not". Each group must write down their answers.

Step 3

When all the groups have answered all the questions on their respective cards, they are given the classification labels that are identical to those on their respective cards and asked to stick them in their appropriate boxes on Fig. 1.1. The chart is then displayed in the classroom for some time for the learners to copy in their notebooks.

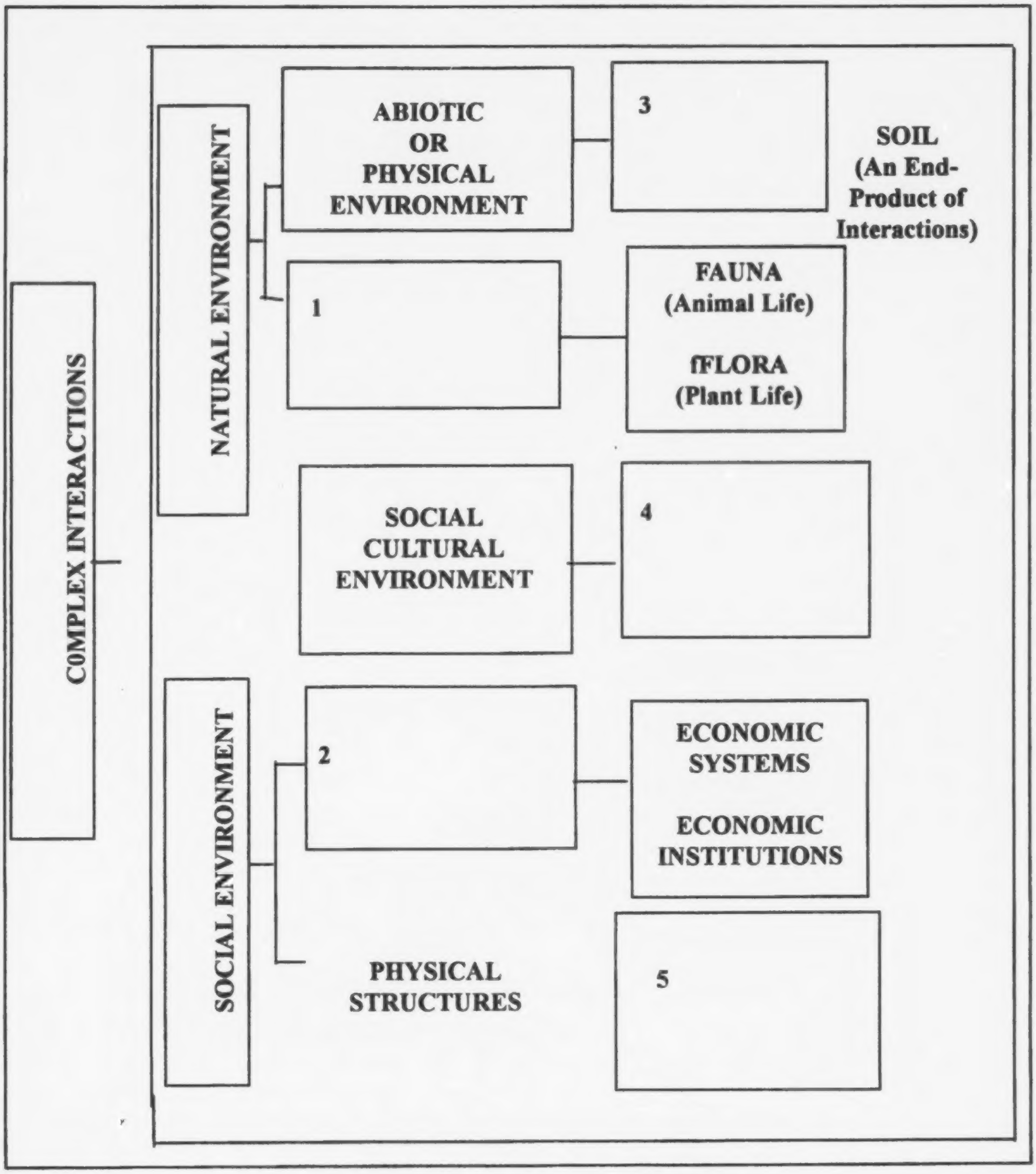

C0MPLEX INTERACTIONS
NATURAL ENVIRONMENT
ABIOTIC OR PHYSICAL ENVIRONMENT
3
SOIL (An End-Product of Interactions)
1
FAUNA (Animal Life)
fFLORA (Plant Life)
SOCIAL CULTURAL ENVIRONMENT
4
SOCIAL ENVIRONMENT
2
ECONOMIC SYSTEMS
ECONOMIC INSTITUTIONS
PHYSICAL STRUCTURES
5

Fig. 1.1 The main components of the environment

CARD A

ATMOSPHERE
(AIR)
HYDROSPHERE
(WATER)
LITHOSPHERE
(ROCKS)

Does this card belong to box	5?	YES/NO	WHY/WHY NOT?
	2?	YES/NO	WHY/WHY NOT?
	4?	YES/NO	WHY/WHY NOT?
	1?	YES/NO	WHY/WHY NOT?
	3?	YES/NO	WHY/WHY NOT?

CARD B

SOCIAL INSTITUTIONS
CUSTOMS
BELIEFS
POLITICAL SYSTEMS
AND INSTITUTIONS

Does this card belong to box	3 ?	YES/NO	WHY/WHY NOT?
	1 ?	YES/NO	WHY/WHY NOT?
	5 ?	YES/NO	WHY/WHY NOT?
	2 ?	YES/NO	WHY/WHY NOT?
	4?	YES/NO	WHY/WHY NOT?

CARD C

RURAL LANDSCAPE
INFRASTRUCTURE
BUILD-UP AREAS
FIXED INDUSTRIAL PLANT
MOVABLE MACHINERY

Does this card belong to box	3?	YES/NO	WHY/WHY NOT?
	1?	YES/NO	WHY/WHY NOT?
	4?	YES/NO	WHY/WHY NOT?
	2?	YES/NO	WHY/WHY NOT?
	5?	YES/NO	WHY/WHY NOT?

CARD D

**LIVING OR
BIOTIC
ENVIRONMENT
(Biosphere)**

Does this card belong to box	**3?**	**YES/NO**	**WHY/WHY NOT?**
	5?	**YES/NO**	**WHY/WHY NOT?**
	2?	**YES/NO**	**WHY/WHY NOT?**
	4?	**YES/NO**	**WHY/WHY NOT?**
	1?	**YES/NO**	**WHY/WHY NOT?**

CARD E

**ECONOMIC
ENVIRONMENT**

Does this card belong to box	**3?**	**YES/NO**	**WHY/WHY NOT?**
	1?	**YES/NO**	**WHY/WHY NOT?**
	5?	**YES/NO**	**WHY/WHY NOT?**
	4?	**YES/NO**	**WHY/WHY NOT?**
	2?	**YES/NO**	**WHY/WHY NOT?**

Step 4

Now each group is asked to list examples of items or objects and processes which belong to the following classes:

a) Atmosphere (air)
b) Hydrosphere (water)
c) Lithosphere (rocks/crust)
d) Fauna (animals)
e) Flora (plants)
f) Social institutions
g) Customs
h) Beliefs
i) Political institutions
j) Economic systems
k) Economic institutions
l) Physical constructed structures
m) Factories
n) Movable machines

Interdependence in the Environment

From what we have covered above, you can see that the environment is composed of both living and non-living things. The term *biological diversity* is used to refer to the variety of life that exists in a given environment. For example, a lake or a pond contains both living and non-living things. The living things depend on one another as well as on the non-living things in their environment. Such interdependence is for food, shelter, breathing and so on.

Areas in which animals, plants and non-living things are interdependent, such as forests, swamps, lakes, and rivers, are called ***ecosystems.***

Ecosystems

This is a functional unit of living and non-living things interacting to form a stable and self-sustaining system. It involves the exchange of food, materials and energy. The main objective of this internal interaction is to bring about a continuous self-supporting environment through cycling and recycling elements essential for life. An examples of how elements in ecosystems interrelate is illustrated below.

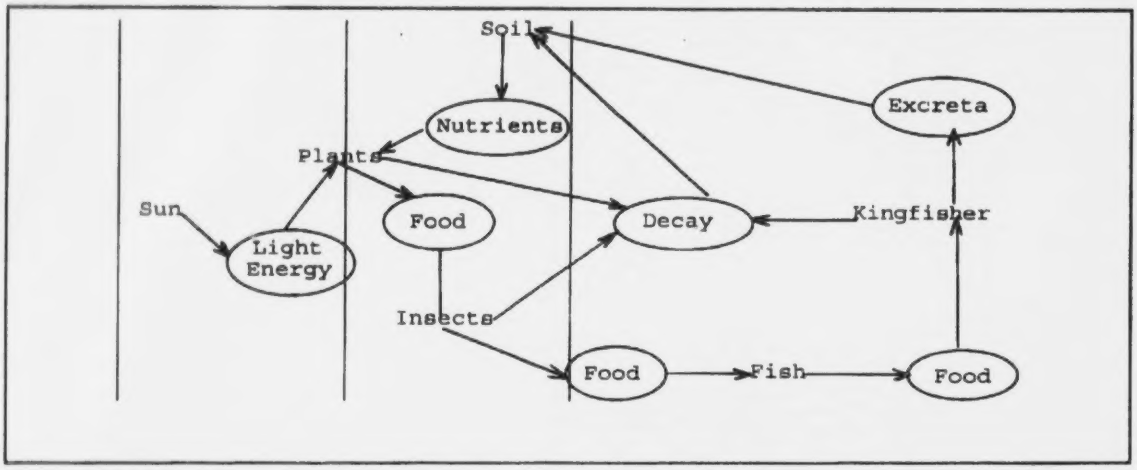


Fig. 1.2: Inter-relationship of selected elements in an ecosystem

Activity 1.C Studying Ecosystems

In order to help the learners perceive an ecosystem as a dynamic environmental entity, you should prepare a field activity. It should involve the following basic actions:

(a) The learners should survey the territory around the school or their homes and identify areas that can be classified as ecosystems.

b) They should attempt to list the organisms that exist in each of the ecosystems.

c) Finally, the learners should describe the various ways in which the organisms depend on their physical environment and on each other.

Food Chain

Another example to illustrate the interrelationship and independence among the components of the environment is the food chain.

Plants and animals usually do not live singly. They live in groups with other plants and animals. In any community you will almost always find green plants and animals feeding on them. Such animals that feed on plants are called herbivores. You will also find other animals feeding on the herbivorous animals. These animals which feed on fellow animals are known as carnivores, or carnivorous animals. There are also microscopic organic matters. These bacteria are called decomposers because they are capable of breaking down dead plant and animal material to basic minerals. Such minerals are absorbed by plants. Then animals like, antelopes, goats and cattle eat the plants; humans and some wild animals eat meat of the animals which feed on plants; and thus the chains go on.

A food chain therefore is a description of how animals and plants get their food. In other words, it is a relationship expressed in terms of who eats what in the environment. Two examples of food chains are provided in Figure 1.3.

1. **Hawks eat snakes, which eat lizards, which eat grasshoppers, which eat grass, which absorbs soils and mineral salts.**
2. **Mongoose eat snakes, which eat frogs, which eat insects, which eat plants, which absorb mineral salts in the soil.**

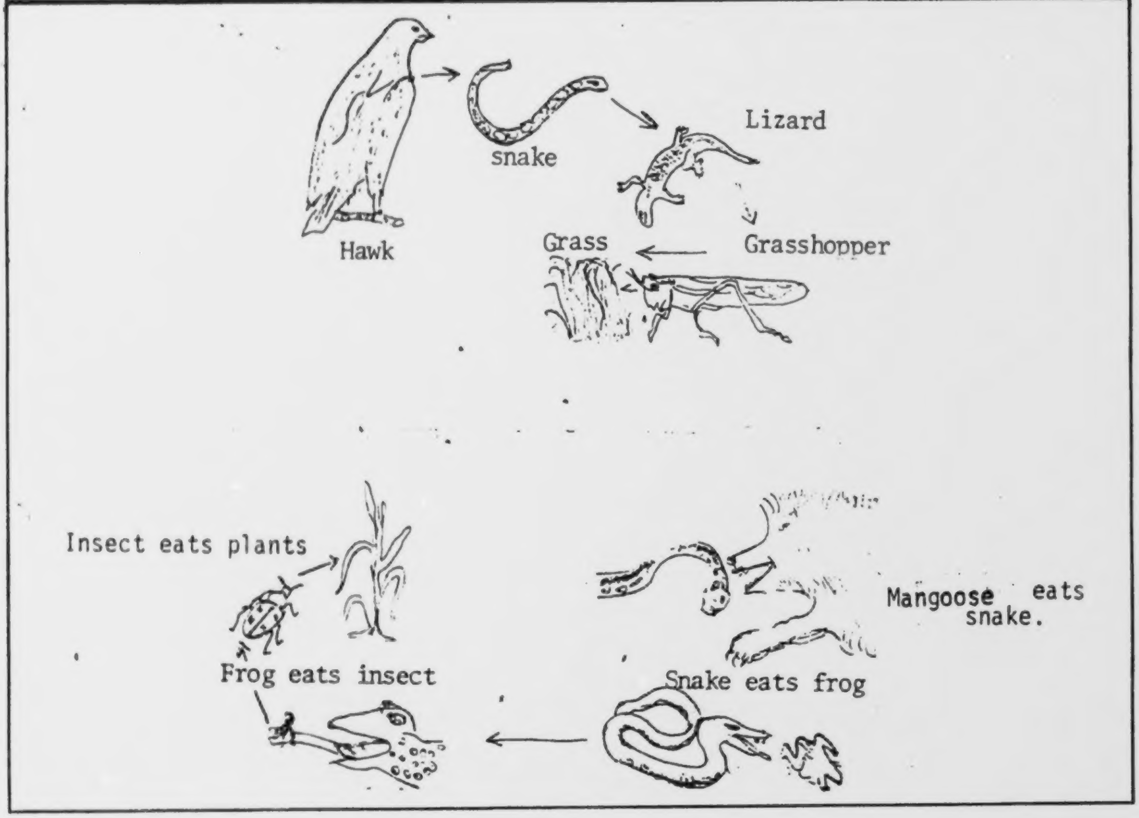


Fig. 1.3 Two examples of food chains

As it can be seen in a food chains, if any one element is missing, the chain is broken and the whole community is affected. Hence many members of the community may die of starvation. For example, if there are no frogs, the snakes will die of starvation. Similarly, the hawks will also die if there are no snakes. The number of insects will then increase. Soon they will eat and deplete all the plants. Thereafter insects will also die of starvation.

It follows also that, if the number in any one group increases, the whole community is affected in some way. However, when undisturbed, nature keeps the balance within a given ecosystem.

Food Webs

In real life, food relationships do not remain as simple as depicted in the above examples. This is due to the fact that one organism may be food for several other members of the ecosystem. This gives rise to a complex network of food chains called a *food-web.*

Below is an illustration of a simple food web. Use it to describe the 'who eats what' relationship.

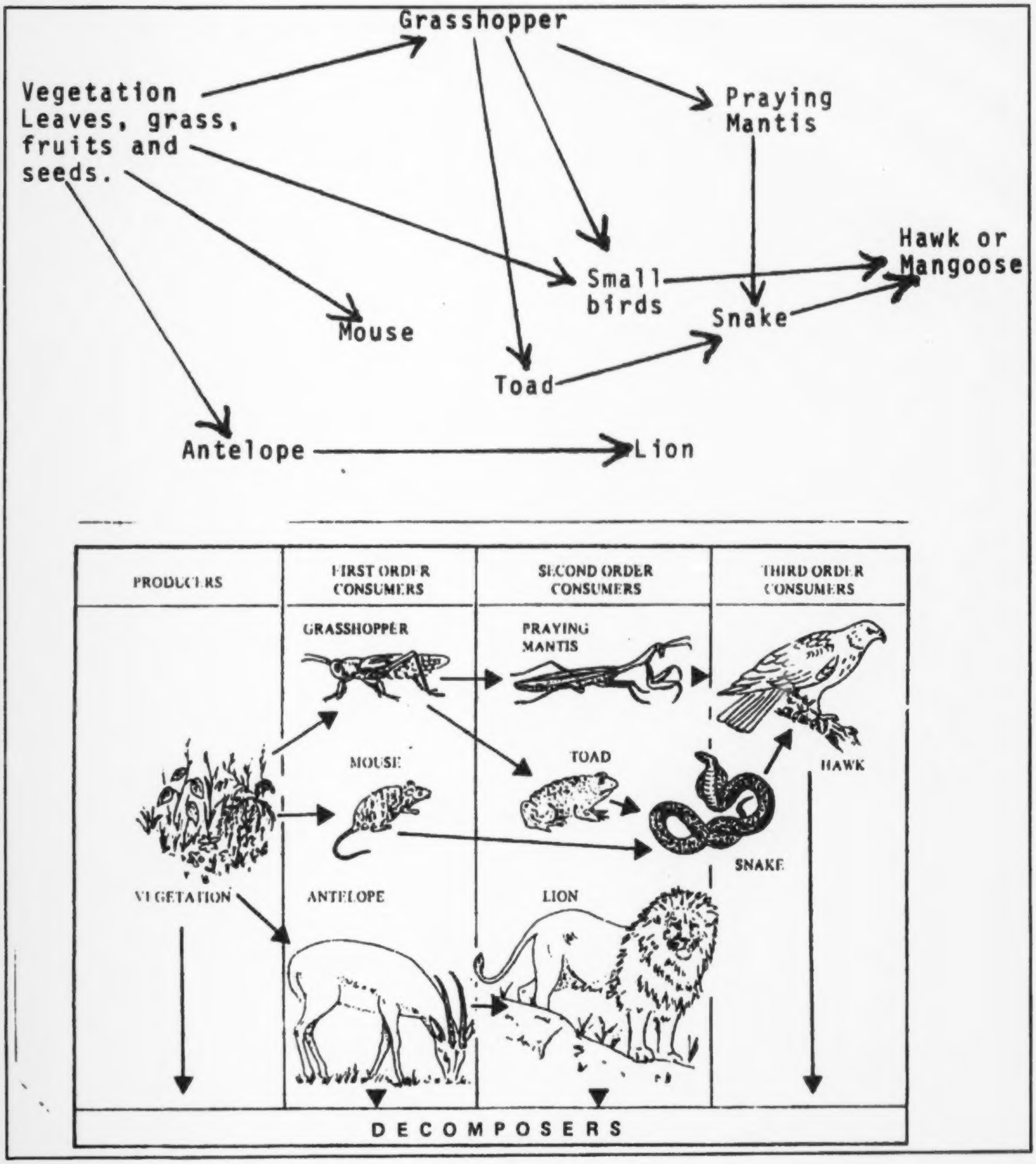

Grasshopper
Vegetation Leaves, grass, fruits and seeds.
Praying Mantis
Hawk or Mangoose
Small birds
Snake
Mouse
Toad
Antelope
Lion
PRODUCERS
FIRST ORDER CONSUMERS
SECOND ORDER CONSUMERS
THIRD ORDER CONSUMERS
GRASSHOPPER
PRAYING MANTIS
MOUSE
TOAD
HAWK
SNAKE
VEGETATION
ANTELOPE
LION
DECOMPOSERS

Figure 1.4 A simple food web

Source: Adapted from Investigating Living Animals and Food Consumers. UNESCO Pilot Project for Biology Teaching in Africa, 1968.

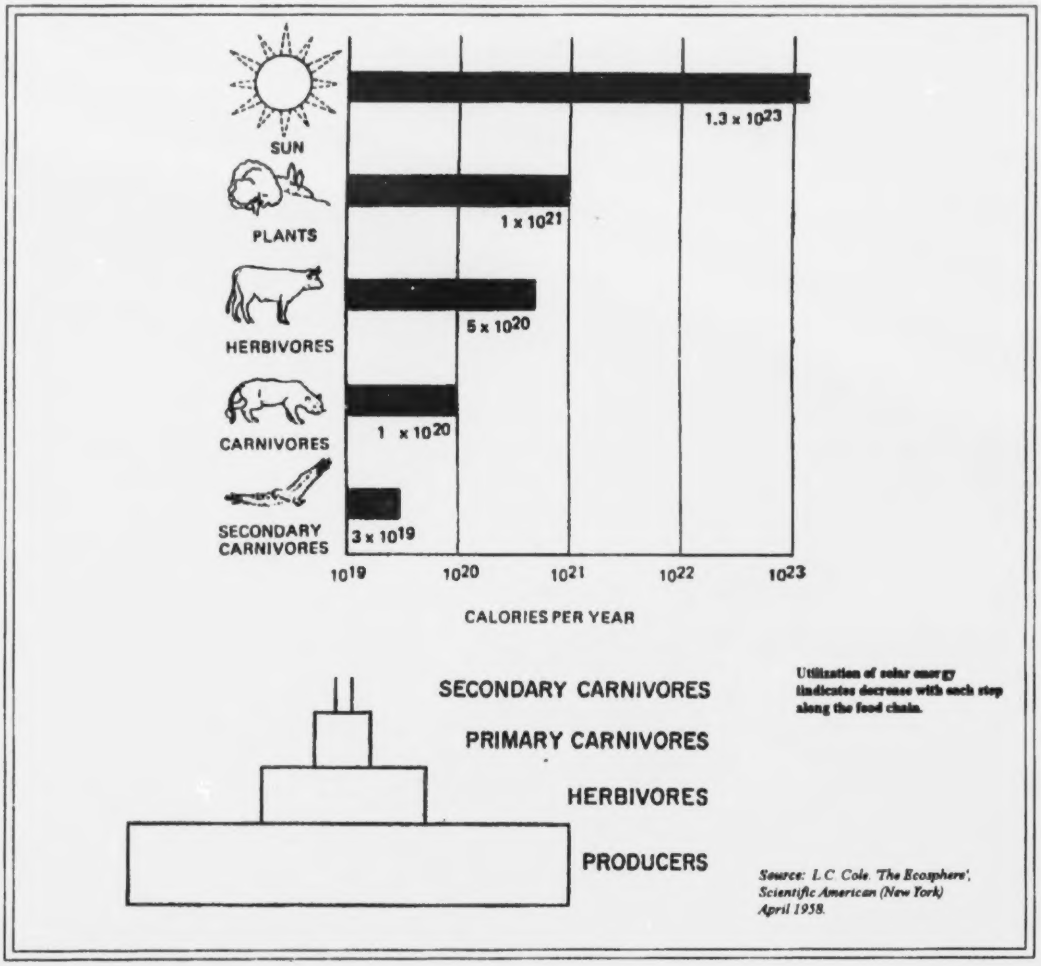
Activity I.D
Students identify and list:

a) Animals that feed on plants.
b) Animals that feed on other animals.
c) Plants that eat other plants.
d) Things that humans feed on.
e) Species in their ecosystem that have been depleted because of human activities and other animals.

Now they can explain how all this interference has affected food chains in the area.

The Energy Pyramid

We all know that animals and plants do not consume foods for the sake of doing so. Food is the source of the *energy* that living organisms use for growth and other activities. The very origin of the energy which is stored in food is the sun. Figure 1.4 briefly explains the transfer of energy from the sun to living organisms.



Utilization of solar energy lindicates decrease with each step along the food chain.

Source: L.C. Cole. 'The Ecosphere', Scientific American (New York) April 1958.

Note: Organisms that collect solar energy such as plants are called producers. They have the greatest population in the chaim. The number decreases along the chain, thus, forming an energy pyramid of producers and consumers.

Figure 1.5 The transfer of energy in the environment (the energy pyramid)

Environment, Development and Sustainability

Today the terms *environment* and *development* have become so interlinked that one cannot refer to any of the two without referring to the other. Another key term which constitutes a crucial bridge between environment and development is *sustainability*. Let us briefly elaborate on these three terms.

Sustainable Development

In simple terms, the former Executive Director of UNEP. Dr. Mustafa Tolba defined sustainable development as "development without destruction" of environmental resources.

Sustainable development provides a lasting and secure livelihood that minimizes resources depletion and environmental degradation, without causing cultural disruption and social instability. It is an interaction among the biological systems, resource systems, and the social systems. It seeks to maximize the achievement of goals across all these systems through prudent decisions and actions.

It involves the satisfaction of basic human needs for food, clean water, fuel, shelter, health and education, freedom from pollutants and disease, and maintenance of the biological systems which provide the basis for all life.

Balance of Nature and Land Carrying Capacity

What do we mean by these two expressions "balance of nature" and "land carrying capacity"? Well, land can be compared to a donkey, mule or camel that carries a load. The animal will move with increasing difficulty whenever its load is increased. At a particular level of weight, the animal may be unable to move at all due to excessive weight. Any further loading may cause the animal to collapse under the load, and may cause injuries. As we have seen, land supports plants, animals and human populations. The total number or the right proportion of all these that the land or an area can support is called the *carrying capacity* of that land or area.

The balance of nature referred to in this chapter can be maintained as long as the *land carrying capacity* is respected. This is the number of animals and people that can be supported by a piece of land without causing irreversible damage to the soil. A key consideration in determining land carrying capacity is its soil, climate, vegetation as well as ability to replace the lost vegetation and mineral salts.

Regardless of climate, the nature of the soil and its potential, land must not be used beyond its carrying capacity. If this is done, not only will the plants and animals reared on it be of poor quality, but also most importantly, the land's carrying capacity itself will diminish. Eventually the land may turn into a desert.

Sample Lesson I

Introduction

This lesson is presented as a series of classroom activities designed to demonstrate that the environment and people all form a system. It is simple enought to be suitable for use by teachers across all primary school classes. The level of difficulty can be varied by moderating the depth of analysis that you demand from the class.

Objective

By the end of this lesson you will be able to guide your pupils to demonstrate the inter-connectedness of all elements in the environment by

a) Constructing environmental webs
b) Describing the inter-relationships among elements in the environment.

Resources

1. A long strong string of rope about 25 metres

2. A diagram of a simplified model of the environment (Figure 1.1)
3. A razor blade or a pair of scissors.

Procedure

Step I

Learners generate functional definitions of the term *environment*. Active techniques such as questioning and use of dictionaries should be utilized to formulate the definitions. You should then help to refine the learners' definitions.

Step 2

Utilise an activity similar to 1.A and 1.B on pages 2 to 3, or a study of the expanded version of figure 1.1 in order to help the class to further understand the composition of the environment.

Step 3

Now the class should perform the following activity which is designed to demonstrate the many connections among elements in the environment.

a) Ask the pupils in the class to allocate themselves names of elements in the environment (e.g. tree, grass, soil, human being, river, lake, rain, etc). All these names should be written in a scattered manner on the chalkboard as they are mentioned.

b) Call out the name of one of the items. The respective holder of the name should answer to the name. For example, if you call out 'tree' the holder should reply, 'I am a tree'; then one end of the string is handed over to him/her and tied firmly on the finger or simply held firmly.

c) Ask 'tree' to name one item on which he/she depends much for survival, say, soil. The roll of the string is then handed over to 'soil' while tree holds the other end. Soil also names one item on which he/she depends, and the process of handing over one end of the string is repeated, making sure that each person/item named holds on to a part of the string, while the latter is kept well stretched.

d) The activity continues until everyone in the classroom has been named at least once or until the entire string is used up; whichever comes first. It is alright for any item to be named several times during this activity.

Tip: At the end of the activity the continuous string network is likely to look like Figure 1.5 and it represents an *environment web*.

e) Now lead the pupils to recognize that things are so interconnected that an event affecting one element can have many consequences. For example, ask one pupil to cut his/her link with another pupil. Let the class observe and describe what happened to the rest of the web. Guide them to apply their observations to an environmental situation , citing actual items from Figure 1.4 and from the local environment.

f) Extend the lesson to constructing food chaims, involving the elements represented in the classroom. The pupils themselves ought to construct the food chains.

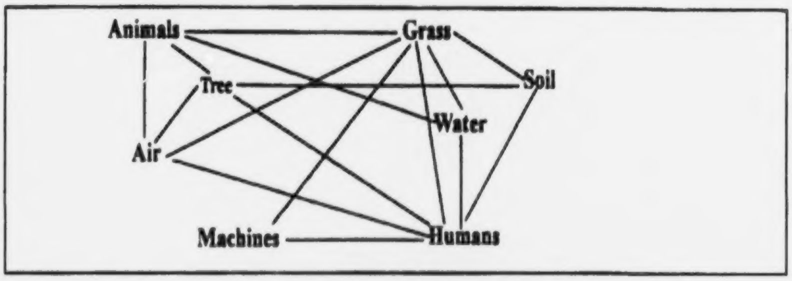


Figure 1.6. An extract of a simple environmental web

Evaluation

1. Instruct the pupils to work in groups of three or four and draw an environmental web for an ecosystem of their choice, such as, a swamp, forest, grassland, plantation, nature reserve, a section of a river valley, etc. They may need to do some field or library research on this subject before they establish the web.

2. Ask each group to identify two actions of human interference with links in the web and to predict the effects of such interruptions on the ecosystem.

3. To consolidate the class's understanding of the environment as an interconnected set of elements, tell them to look up the word system in the dictionary. Ask them to explain how it applies to the environment.

Sample Lesson II

Introduction

This activity is for the upper years of primary, preferably those above year five. It is in reported format, and is intended to serve as an example of how to organise role play activities for your class. Joyce Nnansubuga, the character involved, is a teacher at a primary school in Rakai district of southern Uganda. Her seventh year class is learning about atmospheric pollution.

Objective

After you have worked through this reported activity, you should be able to organise a mock meeting/ forum on your class or school to discuss environmental issues and to prompt your pupils to forumulate environmentally produnt action programmes.

Statement of the Problem

In 1991, a leader of a major world power categorically rejected the idea of reducing the use of chrorofluorocarbons (CFCs) and controlling the emission of fossil fuel residue gases into the atmosphere in his country, as measures for protecting the ozone layer and prevention of global warming. His reason was that doing so, would cost his country well over half a milliion jobs. The leader suggested that instead, tropical countries should halt deforestation and also expand their forest acreage. This would enhance the protection of the atmosphere.

As far as Joyce is concerned, this statement sets a stage for interesting questions and discussion. The questions are:

a) Are measures like forest conservation and re-afforestation in tropical areas adequate to arrest the depletion of the ozone layer and prevent global warming?

b) Do these measures involve any economic and political risks for the low income tropical countries?

c) Do the views expressed by the major power leader above conform to the idea of global responsibility towards the environment?

c) Who is responsible for the excessive carbon gasses in the atmosphere and who should pay for thier removal?

Resources

1. A model of the environment (Figure 1.1)
2. Notes on the ozone layer and global warming (provided next page).

Notes

OZONE LAYER DEPLETION AND GLOBAL WARMING

a) Life on eath is cririically dependent on the planet's atmosphere. As far as is known, it is only on eath that the atmosphere provides a mixture of gases including water vapor, which allows living things to survice. Besides oxygen, water and, to some extent, carbon dioxide on which the sustanance of life on eath depends, there are small quantities of other gases. One of the most important of these is ozone, a simple molecular compound of three oxygen atoms.

b) Ozone is present throughout the atmosphere in very 'insignificant' quantifies of hardly one part in million units of volume. However, about 25 kilometers above sea level, on the average, ozone is concentrated in a 'layer' that is both thinner and more delicate than an egg's inner membrane. This is the *ozone layer*.

c) The ozone layer acts as a veil that protects living organisms by filtering harmful forms of radiation from the sun, which would cause skin cancer and harm to plant life.

d) Industrial chemicals known as chlorofluorocarbins or CFCs, used mainly in spray cans and refrigeration, can eat away the ozone layer. This is the reason for concern.

e) Global warming is a phenomenon associated with both industrial and agrarian activities. Accelerated devegetation is steadily depriving the earth of a most important air conditioning system which balances oxygen, carbon gases and water vapor levels. In addition, combustion in most vehicles, domestic burning, industries, and other machineries is aggravating the situation by emitting more excessive carbon gases into the atmosphere.

f) Increased release of carbon gases into the atmosphere, coupled with the reduced capacity of the ecosystem to absorb them, has caused the formation of a 'blanket' of these gases in the upper atmosphere which reflects heat back to lower atmosphere, thus trapping more heat around the eath than is normally required. This is what is called the '*greenhouse effect*'[1], which is the main cause of the global warming.

g) Global warming is capable of increasing the average rainfall, but soils would become drier as a result of higher evaporation rates. Expansion of the oceans may lead to a slow but steady rise in the sea levels, and, possibly, melting of the parts of the polar ice caps, leading to coastal flooding.

h) The effects on societies could be widespread and would probably include crop reduction and famine in marginal food producing areas. Sea level changes, might lead to major migrations because of present concentration of populations in some coastal areas. The economic base of many countries, and of international trade, could undergo major upheavals.

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[1] The term "greenhouse effect" is adopted from special warm grass houses constructed in cold lands so that vegetables can grow during winter. They are called "green houses"

Procedure

Joyce organised a mock **World Conference on the Safety of the Atmosphere.** She used the ballot method to decide the country representatives. To make the conference more interesting, she ensured that the industrialized countries and the 'Third World' countries have radically different views on the cause of atmospheric pollution and how to prevent it.

The conference starts with a keynote address delivered by the teacher herself to brief the delegates. It then goes into 'working committee' sessions.

The 'Third World' countries produced the statements below:-

1. At local, national, and global levels, fair play rules should demand that the *polluter pays* for environmental rehabilitation.
2. Low income countries of the world risk violent revolution if they try to prevent forest encroachment by landless peasants without providing alternative settlement and arable land for squatter families.
3. Peasants in the third world cannot afford electricity and many other alternatives to wood fuel.
4. Tropical forests are so severely reduced that they alone are not capable of effectively cleaning up the atmosphere by removing the present high levels of pollutant compounds.
5. Global warming threatens to cause global catastrophe; it is therefore necessary that efforts to prevent it be both national and global.
6. It is disturbing to note that the same technologies which caused atmospheric pollution in industrialized countries, are presently being exported to unsuspecting Third World countries by multinational corporations.

THE TASK

As an exercise, the class prepared arguments that they thought might have come from the developed countries' delegates. They did the following:

1. Question the suggestion that the ozone layer is so seriously threatened, and that global warming is in progress. (Clue: Is there reliable evidence?
2. Argue against some or all the points presented by the Third World delegates.

After the committee sessions, a plenary which involved the whole class together, was convened. The task before it was to reconcile the two radically opposed camps on the issues under discussion, and to formulate an agreeable programme to protect the atmosphere.

Evaluation

Joyce's evaluation was mainly by classroom observation. It emphasised, among other aspects, active participation, contribution to debate, weight of arguments, and evidence of having read around the subject. She also asked her students to prepare statements of what they each intended to do to protect the atmosphere now and later when they grow up.

CHAPTER TWO

ENVIRONMENTAL EDUCATION IN PERSPECTIVE

Introduction

Environmental Education (EE) is increasingly assuming enhanced attention and status in the education systems of many countries. Factors responsible for this development are many and varied. This chapter outlines the events that led to the present status of EE as well as its rationale, goals, objectives and guiding principles. It also briefly addresses the status of EE in the school curriculum. A sample lesson is provided at the end of the chapter.

The content in this chapter is meant for *you* as a teacher. If you are a *primary school teacher* you should *not* attempt to teach it to your pupils. However, if you are a *teacher educator,* your students *need to know* what is in this chapter. Therefore it should be part of the environmental education contents that you teach your trainees.

Objectives

After reading this chapter you should be able to:

1. Define education.
2. Define Environmental Education (EE).
3. Outline the history of EE.
4. Explain the rationale for EE.
5. Identify the goals, objectives and guiding principles of EE.
6. Explain the part played by EE in the school curriculum.
7. Be able to design a well conceived and balanced teaching lesson in EE.

The Meaning of Environmental Education

In chapter one we defined the term *environment.* You should remember that definition all the time.

Environment means the surrounding conditions which influence behaviour and development of living things.

But what is *education*? First, we shall look it up in a dictionary and write down its meaning. Here is an example drawn from one dictionary. It says that education is:

1- the act or process of imparting or acquiring knowledge, developing the power of reasoning and judgement, and generally preparing oneself or others intellectually for mature life.

2- the act or process of importing or acquiring particular knowledge or skills, as for a trade or profession.

If we take the two words *environment* and *education* together we can construct another term. That is *environmental education.* In simple terms, this expression refers to 'education about the environment'. However, environmental education is more involved than that; it should be seen as a process of:

learning *about* the environment, *from* the environment and *for* the environment.

If we relate it to knowledge, attitudes and skills, then we can define environmental education as:

a process of learning and teaching knowledge and skills which enable us to understand and appreciate our surroundings and the interrelationship between us, our culture and resources.

There has always been some association between the environment and education. Informally this association has been through folklore, while formally it has been through organised teaching about the environment and its relationship to people. However, during the past twenty years or so EE has increasingly moved to the centre of many education systems. Let us take a closer look at this evolution.

History of Environmental Education

Traditional Environmental Education

Pre-history communities lived relatively simple lives. They survived by gathering vegetative food and by hunting. Their homes were natural shelters, such as trees and caves. As communities gradually developed, they made tools and fire. Population increased, and so did the needs of people. Communities started to grow food and to keep animals.

The most important benefit of that simple life was that people took only what they needed from the environment for food, shelter and some clothing. Also during this phase, which lasted in much of Africa up to the beginning of this century, environmental knowledge and skills were traditionally passed on from generation to generation through practice (work), folklore (story telling, drama and play) and rituals. To this end, therefore, EE is not a new idea in traditional societies on the continent.

Activity 2.A *Traditional Environmental Education*

1. Learners should research on folklore stories, legends, and poems that teach about the importance of the environment and natural resources.
2. Let the class research on various incidents of environmental problems such as floods, droughts, earthquakes, deforestation and others. Putting together the information collected, you should show how the various disasters have led to environmental awareness.

New Dimensions

The simple lives of communities began to rapidly change during the Agrarian Revolution and the Industrial Revolution of the eighteenth and nineteenth centuries respectively in Europe. The pressure on natural resources increased tremendously, and large quantities of waste were produced in the new industrial economies of Europe and North America. These new developments led to pollution and endangered natural resources in many parts of the world. This came about largely because these expanded economies led to colonisation and exploitation of resources in Africa, Asia and South America.

By the late nineteenth century, around 1860-1890, a few writers in Europe were already using their writings to point out that careless exploitation of resources and uncontrolled disposal of waste were threatening the environment. The warnings grew into campaigns for the total preservation of resources. By the 1940s much of the campaigns were focussing on mobilizing the youth to fight against environmental abuse.

During the 1960s, international concern about sensitive and balanced response to the challenges of the environment steadily grew, and culminated into important international events during the following decades. Four of these events are summarised in the box below.

Landmarks in the History of Environment and Sustainable Development

Event		*Venue*	*Main Significance*
1.	The United Nations Conference on Human Environment	Stockholm, Sweden: 1972	Produced the Stockholm Declaration Led to the creation of UNEP
2.	The Inter-Governmental Conference on EE	Tbilis, Georgia in the former USSR: 1977	Articulated for the first time the broad philosophy, goals and principles of EE
3.	Our Common Future, the Report of the Environment and Development	United Nations, New York, 1987	For the first time the Report articulated and politicized at the global level the strong linkage between the environment and development. Recommended the process which culminated into the June 1992 Rio Conference.
4.	The United Nations Conference on Environment and Development (UNCED) popularly known as the Earth Sumit.	Rio de Janeiro, Brazil, June, 1992.	Recognized the integral and interdependent nature of the earth. Adopted a set of principles to guide future development. The most relevant of such sets of principles to EE is known as Agenda 21.

Landmarks, such as those highlighted above, together with similar developments at national and regional levels, inspired major programs in Environmental Education in various countries.

Rationale of Environmental Education

Once Dr. Mostafa Tolba, the former Executive Director of UNEP, observed that ignorance is one of the most important causes of environmental impoverishment. He stated further that with an adequate system of information, we can learn not only to avoid the mistakes of others, but also to benefit from others' achievements.

In Africa, virtually all the countries display characteristics and challenges that EE can and should effectively address. Among these are, the following:

1. Low levels of economic development;

2. High birth rates and low death rates with high population increase, which range between 2.5 and 4% p.a.;

3. A young population where more than 50% of the total population is below 15 years of age;

4. Increasing urbanization with a marked rural-urban drift, and

5. The urban challenge of solving the problems of congested living areas, inadequate shelter, under-employment, unemployment and the imprudent use of the available forms of energy.

These trends are increasingly felt and are likely to slow down planned development, by putting pressure on the natural resources.

The rapid population increase also has the effect of worsening current environmental problems, such as:

1. Land degradation;
2. Accelerated soil erosion;
3. Desertification;
4. Undernutrition and malnutrition;
5. Energy misuse and waste;
6. Pollution, and
7. Environmental diseases.

Governments are therefore trying to use education to promote good environmental practices. Due to its function as the paramount agent for changes in attitudes and behaviour, education is the main factor of development. It contributes directly to individual satisfaction and know-how. It also prepares the individual physically, mentally and morally for a changing role in his/her community, nation, region and the world. These aspects of human development can be effectively used to conserve and protect the environment.

The preceeding few paragraphs suggest that Environmental Education has a key role to play in the social, economic and political development of our countries. Let us now go a bit further and look at the goals, objectives and principles of EE.

Goals, Objectives and Principles

In fine, these will vary from country to country, or from one region to another. In general, however, the goals, objectives and guiding principles of EE are agreed upon, and were summarised by the Tbilis Conference as follows:

Goals of EE

1. To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;

2. To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment, and

3. To create new patterns of behaviour of individuals, groups and society as a whole towards the environment.

Objectives of EE

The categories of Environmental Education objectives were also stated at Tbilisi. They are:

1. *Awareness*: which helps social groups and individuals acquire an awareness of, and be sensitivity to the total environment and its allied problems.

2. *Knowledge*: which helps social groups and individuals gain a variety of experiences in, and acquire a basic understanding of the environment and its associated problems.

3. *Attitudes:* which help social groups and individuals acquire the skills for identifying and solving environmental problems.

4. *Participation:* which provides social groups and individuals with an opportunity to be actively involved at all levels in working towards resolution of environmental problems.

Guiding Principles

The Tbilisi Conference formulated some *guiding principles* for Environmental Education. It suggested that Environmental Education should:

1. consider the environment in its totality - natural and built, technological and social (economic, political, technological, cultural-historical, moral, aesthetic);

2. be a continuous lifelong process, beginning at the pre-school level and continuing through all formal and non-formal stages;

3. be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

4. examine major environmental issues from local, national, regional and international points of view so that students receive insight into environmental conditions in other geographical areas;

5. focus on current and potential environmental situations, while taking into account the historical perspective;

6. promote the value and necessity of local, national and international co-operation in the prevention and solution of environmental problems;

7. explicitly consider environmental aspects in plans for development and growth;

8. enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;

9. relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;

10. help learners discover the symptoms and real causes of environmental problems;

11. emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills, and

12. utilize diverse learning environments and a broad array of educational approaches to teaching/learning about, and from the environment with due stress on practical activities and first-hand experience.

Activity 2.B *Reflection and Discussion on the Practical Value of EE as a Field of Study*

1. Ask students to quietly read the following passage.

The Point of Departure: Words of Dr. Walter Leal Filho-3

There is a consensus among specialists that Environmental Education is closely associated with the promotion of sustainable development. In fact, the latter cannot be reached without the former. All treaties signed at Rio have an awareness raising dimension to which Environmental Education can actively contribute. UNESCO and UNEP, which together run the International Environmental Education Programme (IEEP), see it as "the means to get solutions implemented.".

2. Have them briefly individually respond to the three concerns below, jotting down their respective points.

    a) To what extent is Environmental Education used to promote social, political and economic aspects in your country?

    b) List three main factors or problems which tend to limit the use of Environmental Education as a tool in the process of raising awareness for sustainable development.

    c) Precisely suggest practical measures that can help Africa surmount these difficulties.

3. **Let the class divide into small groups, review and discuss the individual responses. Each group should come up with a concesus response which should be formally presented to the whole class by representatives of the different groups.**

4.. Either the teacher or one of the learners should note the key points of this reflection and discussion on the board.

Present State of EE in the School Curriculum

Problems of Acceptance

Despite its great potential as a tool of raising awareness for sustainable social, political and economic development, Environmental Education has not yet been widely accepted and implemented in schools, especially in developing countries. Today, there is a large gap between the level of the use of EE in the curricula in the industrialized countries on the one hand, and in developing countries on the other. The latter are lagging far behind and the main reasons for this are summarised in the box below.

Major Constraints of EE in the School Curricula in Developing Countries

1. **Lack of Official recognition**
   Globally, less than a quarter of the nations have effectively implemented Environmental Education strategy in school curricula. Most of the world's developing and least developed countries are among the remaining $^3/_4$ that have not implemented Environmental Education.

2. **Lack of funds**
   This problem which is persistent in developing and least developed countries presents a major hurdle to the development of Environmental Education. Normally no special allocation exists. As a result of this, the purchase of teaching materials and the execution of field work become quite difficult.

3. **Lack of infrastructure and resources**
   There is an acute lack of infrastructure and resources to support and sustain the development of Environmental Education in these countries. While, for example, resources such as audio visual materials, textbooks, teaching resources and the packs are plentiful in North America and many Western European countries, they are largely unavailable in the majority of developing nations, let alone the least developed countries.

The factors summarised above are not exhaustive. A number of other problems can be identified and included. One such problem is the one of lack of adequately trained personnel.

In developing and least developed nations most teachers have not had any formal training in Environmental Education. Largely due to lack of this training, they are reluctant to teach a wide range of environmental topics in schools. They also hesitate to embark on a field of study where they might be required to respond to questions they are incapable of handling.

The above observations suggest therefore that in addition to official recognition, proper infrastructure and appropriate funding, as well as provision for training should be a priority in developing Environmental Education in a country.

How this Book will Help

Through using this book you will become familiar with the priority areas and concerns in respect of which EE educators need most assistance. These will include, for example, the following concerns:

1. Enhanced teachers' awareness of major environmental problems in their respective communities, countries, regions, etc.

2. Competence to effectively utilize a wide rage of teaching methods, techniques and strategies.

3. Appropriate techniques in evaluating EE learning.

Some Positive Observations

So far the preceeding paragraphs have drawn a rather depressing image of the present state of EE in schools in developing countries. However, in some African countries some commendable progress has been made. Only a few examples will be cited.

In general, in African countries where EE has gained a position in school curricula, it is taught either as an integrated dimension of other subjects like social studies, science and agriculture, or as a distinct discipline. In Botswana the Junior Secondary school syllabus provides a good example where EE is taught as an integrated dimension of another subject. Other countries with a similar approach include, for example, Tanzania and Kenya. In Zimbabwe, however, Environmental Education is taught as a separate subject in the primary schools.

Sample Lesson

Introduction

The sets of activities in this lesson are intended for student teachers in both pre-service and in-service programmes. They will also be found quite suitable for seminars and workshops organized by and/or for teachers.

Objectives

By the end of the lesson learners should demonstrate competence to:

1. Outline the evolution of Environmental Education globally, linking it to the present state of EE in their respective nations.

2- Briefly explain the present status of EE in the school curricula, highlighting the leading constraints and possible solutions.

3. **Identify and describe priority areas and aspects of training that future EE educators mostly need in Africa.**

Topics

1. Some key landmarks in the development of Environmental Education: Their importance and linkages.

2. Environmental Education has had a slow and hesitant start in African school curricula. Discuss this observation with special reference to the present status of EE in the curricula, its main constraints and possible solutions.

3. To what extent is the training of personnel a limiting factor to the effective introduction of EE in the curricula of African schools. Suggest a realistic measure that might help improve the situation.

Procedure

Each of the above three topics should be adequate to occupy the class for one full lesson. If the three topics are to be covered, three lessons will be required.

1. In respect of each topic, map out the main broad aspects that need to be researched or/and considered.

2. Divide the class into as many groups as is appropriate to cover the identified aspects.

3. As much as possible make relevant background reading materials available to the learners.

4. The learners in groups do the necessary research, discussion and reporting to the whole class on the subject.

Evaluation

The technique of group discussion utilised in this lesson presents you with the challenge of evaluation at two levels. First, you have to establish that the group discussions steadily progress towards the stipulated ends. Second, you have to monitor the needs and level of participation of each individual in each group.

Two ways of ensuring this are suggested.

1. During the discussion, closely move from group to group noting down the points that will call for clarification and summarizing at the end of the group presentations.

2. Make frequent use of the "Evaluation of Self and Group" form. With it, learners can evaluate their own participation and the group's interactions as a whole.

EVALUATION OF SELF AND GROUP

Instructions:

Check the response that best fits your feeling about yourself and the group you have been working with.

Date:
Name:
A- most all of the time, B- frequently,
C- average, D- not often, E- did not do

SELF 1. I participated by making suggestions, arguing and discussing.	A	B	C	D	E
2. I cooperated by listening to others and tried to work out difficulties (compromises)					
3. I am satisfied that I did my best to accomplish the group task.					
GROUP 4. The group made a real effort to accomplish the group task.					
5. The group worked well together by co-operating with each other.					
6. The group shared the responsibilities: no one was left out.					

References

1. Webster's Encyclopedic Unabbridged Dictionary of the English Language; 1989 Eddition, New York, N.W,. U.S.A.: Portland House.

2. The Tbilisi Conference Report

3. Dr. Walter Leal Filho is a Brazian-born environmental scientist and Head of the Research Unit on Environmental Education and Development at the University of Bradford, U.K. (Network No.28 July 1993 Page 3)

CHAPTER THREE

WHAT IS KNOWN ABOUT LEARNING, REMEMBERING, AND EFFECTIVE TEACHING WHEN APPLIED TO ENVIRONMENTAL EDUCATION

Introduction

This is a chapter on research that will explore what is known about learning, remembering, and effective teaching. The two chapters that preceded this one, the first on the meaning of the term environment and the other on Environmental Education in perspective offer a foundation for understanding the purpose for teaching EE and a sense of how this subject might be organized to be taught throughout a curriculum. This chapter will focus on what teachers need to know to effectively put into practice the meaning of Environmental Education and the curriculum.

The Application of Research to Teaching

Teaching in the classroom ought to start with a foundational knowledge on what research tells us about how people learn best. Of course, the question should be asked, Do we know how people learn best? We do know that people learn many different ways. That is, people have different styles of learning. These styles include hearing, seeing, reading, discussing, and participating. It appears that we all seem to respond to some stimulus, and also we seem to respond to different stimuli. Some students can listen to a lecture and learn and remember a great deal. Others seem to achieve more learning from reading, while still others need a direct experience and participation. Some remember best by seeing, while others get the most learning and remembering from discussion. When teachers talk about a style of learning, in reality they are talking about what catches the students' attention, what students respond to. The student must focus attention on a task to achieve learning and remembering. The job of teaching is to help students focus attention on a task.

In summary, research studies on learning and remembering over the past fifty years suggest that students learn and remember what they learn at different rates, all things being equal, according to the degree that students are involved in the lesson. The more students actively participate, that is, co-operate and share in the lesson, the more they will learn and remember because they are focusing attention on a task. Knowing what styles of learning are most effective might be helpful in planning lessons and also would be helpful in writing curriculum materials. The following approximate percentages of learning and remembering are based upon a summary of studies, a composite of many studies and responses from thousands of students. No one person is likely to be exactly represented by any one of the percentages cited here. Keeping in mind the variability among individuals, examine how students are likely to learn and remember

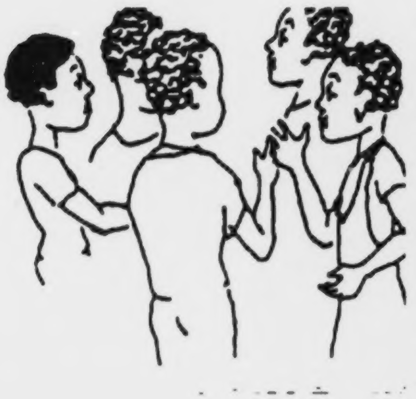
WE LEARN AND REMEMBER:

10% of what we hear
15% of what we see
20% of what we both see and hear
40% of what we discuss with others
80% of what we experience directly or practice
90% of what we attempt to teach others

Would it be accurate to generalize that the more the student has focussed attention and experienced quality time on task, the more likely the higher the percentage (80% or 90%) of learning and remembering?

- **We learn by using our senses and participating in actions**
- **Different individuals learn differently with different learning styles**
- **On the average, we learn more if the learning situation affords us active participation**

Attending to the Task of Active Learning



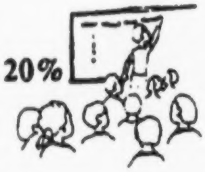
The research on learning and remembering confirms what you already know from your own experience. You do not need to be a trained research specialist to know that most people would learn and remember more if they were to teach the content rather than just hear the content taught in a lecture. Why is this true? The explanation is clear: the teacher must focus more attention on the task of transmitting the content than the student must in receiving the content. The key is concentrating on the task, which is called *spending quality time on task.* Results from most research studies on learning and effective teaching agree that students learn better--learn faster, remember more, and derive greater enjoyment--when they are actively involved in learning. It follows that passive students, that is students who are inactive, non-participating, and indifferent, quickly forget what they learn, are bored, and resist being forced to retain what is to be learned. What one conclusion should you draw from this chapter? Well it seems that activities which focus and prolong attention on the task at hand are more effective in achieving learning and remembering. The least effective are activities that encourage short attention span where minds tend to wander from the task.

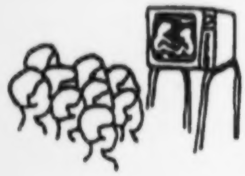
WE LEARN AND REMEMBER 10% OF WHAT WE HEAR during any given period of time. This means that on an average at any given time during a lecture or just listening to the radio students are actually mentally recording only 10% of what they hear, and consequently, at the end of the lecture or radio programme only 10% of the lesson or conversation will be remembered. Keep in mind the importance of learning styles. Some students listen better than others, and that is called *paying attention*, and thus their percentage of learning and remembering what they hear will be greater than that of the average student. Also the percentage of learning by hearing may be greater in those societies where hearing is more important than reading. Studies show that students *tune in and out* when they are listening to a lecture, meaning they listen for a few seconds to the teacher, and then their thoughts stray to something else, and then back to the teacher. They repeat this process of *tuning in and out* to what the teacher is saying during a lecture, or to whatever they may be listening.

Tuning in and out is a process you know from your own experience. It is difficult to hold students' attention to a task if they are just required to hear. But this process of tuning in and out does not just apply to lectures. It also applies to listening to the audio cassettes, to conversations with friends, to anything that is just heard. In short, lecturing can be an effective teaching technique if the students concentrate attention, but research suggests that this is an extremely difficult task, given that students tune in and out, and on the average learn and remember 10% of what they hear.

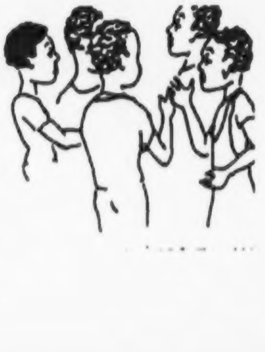
WE LEARN AND REMEMBER 15% OF WHAT WE SEE. It is true that we learn and remember more of what we see than what we hear. For the teacher the problem of having students just see, including reading, looking at pictures, witnessing an event, is that, as we know, people tend to see different things, which is another way of saying we all have selective memories of what we hear and see. In short, seeing does not necessarily lead to accuracy or understanding. The point is that asking students just to read an assignment will result in only 15% learning and remembering. As in the case of hearing, seeing by itself does not encourage quality time on task and often leads to rather passive learning.

WE LEARN AND REMEMBER 20% OF WHAT WE BOTH SEE AND HEAR. Common sense would inform us that combining hearing and seeing is more effective than either just hearing or just seeing. Watching television, seeing a movie, taking notes on a lecture fall into the category of 20% learning and remembering. Try this experiment: listen to the radio, then turn off the radio and watch television. Which caused you focus attention and held your attention for a longer period of time? Television has proved to be a very powerful means of communication because it does require hearing and seeing.



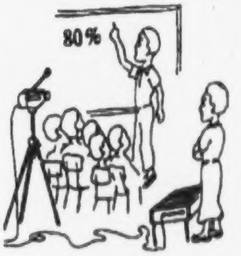


WE LEARN AND REMEMBER 40% OF WHAT WE DISCUSS WITH OTHERS. Suppose you are listening to a lecture. You probably will remember 10% of what you hear. Suppose you take notes during the lecture and see the points made in the lecture written on the chalkboard which reinforces learning and remembering to 20%. Now suppose the lecture is over and you take part in a small group discussion on the topic of the lecture. This improves learning and remembering to 40% if you seriously participate by listening to the other students, responding yourself, and concentrating on the teacher's remarks, in short, if you focus on the topic and integrate the



ideas into your store of knowledge. In this connection, a reasonable generalization could be: learning improves substantially when there is a discussion, particularly if the discussion focuses attention and calls for an exchange of ideas. In other words, the more you put into talking about ideas, the more you get out of the discussion.

WE LEARN AND REMEMBER 80% OF WHAT WE EXPERIENCE DIRECTLY OR PRACTICE. Have you ever practiced an experiment in science, gone on a field trip, practiced giving a speech, participated in a role-play, or participated in a micropeer-teaching? Did you ever practice a sport, or sing with a group? All of these activities could lead to 80% learning and remembering, primarily because they all require your active, undivided attention. If you are really concentrating on playing a game, learning a song, microteaching, giving a speech, observing during a field trip, then your mind is focusing attention on the task at hand. The 80% learning and remembering suggests that the activity you are involved with promotes or encourages a long attention span where your mind is focused on a specific task.



WE LEARN AND REMEMBER 90% OF WHAT WE ATTEMPT TO TEACH OTHERS. Even without research confirming it, common sense and perhaps your own experience informs you that if you teach someone else, you are organizing and reinforcing the content you are teaching, and this activity leads to the highest percentage of learning and remembering. This makes sense simply because to teach, you have to focus your entire attention on the task, and further, sustain that attention for an extended period of time. Almost all teachers know that they actually learned their subject after they had started teaching school. Also studies suggest that co-operative learning, peer teaching, is a powerful way to focus and reinforce what has been learned. Some have suggested that turning students into teachers (tutors) of other students will produce the highest percentage of learning and remembering for those doing the "teaching".

Summary

Do not forget when citing the percentages on learning and remembering that because of preferences for different styles of learning, the percentages are approximations. No one student would probably fit exactly the percentages, but given an entire class or classes, the percentages offer a useful way to view how the students might respond. Lecturing at 10% is the least effective way to help students learn and remember. When you lecture to students you should enhance the learning and remembering of your students to 20% by providing experiences including teaching aids, audio-visual materials, and instructional resources that illustrate what you are trying to say. Further, learning and remembering are greatly enhanced to 40% through class and small group discussion where most students participate, with the highest levels of remembering at 80% occurring when students experience directly or practice the skills they are expected to know. When students teach other students as in peer teaching, the student doing the tutoring is most likely to learn and retain information and understanding at the highest 90% level. In summary, passive and unfocused teaching will yield the least learning and remembering. In contrast, active and focused teaching will tend to prolong attention to learning and remembering. In other words, the higher the percentage of learning and remembering, the more likely the student focused attention and experienced quality time on learning a task. Turn now to a second part of this chapter in which

effective teaching practices that are intended to promote learning and remembering in the classroom will be listed and described.

- **We learn by using our senses and participating in action**
- **Different individuals learn differently with different learning styles**
- **On the average, we learn more if the learning situation affords us active participation**

HOW TO PROMOTE LEARNING AND REMEMBERING

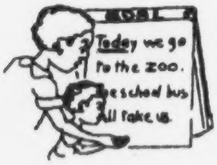
Effective teaching practices which promote learning and remembering include:

1. Goal Setting
2. Accommodating
3. Challenging
4. Feedback
5. Integrating
6. Modeling
7. Reinforcing
8. Rewarding
9. Self-direction
10. Self-esteeem

Suppose as teachers we can help our students learn and remember. Suppose also that you even know how best to help students learn and remember. How do you now apply what you know about learning and remembering to teaching in the classroom? Summaries of research on effective teaching practices have consistently identified several practices that seem to be the most promising. You have learned earlier in this chapter that the key to learning and remembering is focusing attention on the task at hand. Just how do you focus that attention, what is it that a teacher would do in the classroom to focus students on a task? The following eleven effective teaching practices should be a guide for teaching Environmental Education to achieve a maximum of learning and remembering.

1. GOAL SETTING

Effective teaching results from a clear idea of the goal to be accomplished. Goal means the purpose or objective of a lesson. Setting of goals is important to learning and remembering because it focuses attention on what is to be learned. Research shows that when students know the goals or reason for the lesson, they are more likely to successfully complete that lesson. What the goal does is to focus attention on the task at hand. Knowing the task, students can direct their attention to what is to be learned. For example, if the teacher will announce a goal at the beginning of a class period for that day or a week or a term, students are more likely to understand what will be required of them. It seems to be important to learning and remembering if you know where you are going and how you are to get there.



2. ACCOMMODATING

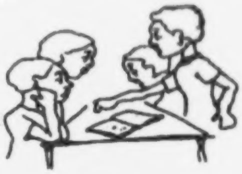
Effective teaching accommodates students' needs and learning styles. This is particularly important to remember when working with special students, those who are mentally handicapped or visually or hearing impaired. It is obvious that all students do not come to the classroom with the same level of maturity, the same level of intellectual gifts, or the same level of skill development. Accommodating is literally providing for, which means adapting and adjusting to the needs and learning styles of students. Learning styles refer to the students' preferences for seeing, hearing, or participating in the lesson. Accommodating is finding alternative ways of appealing to different learning styles.

ORAL REPORTS

3. CHALLENGING

Effective teaching involves a challenging experience which questions, disputes, raises doubts, or suggests a reasonable risk. A challenge requires the full use of a student's abilities and energies to perform a task. For example, propose to the class an unfamiliar or uncomfortable situation such as students giving oral reports on the issue of the ozone layer, role playing, or debating the best way to promote economic development in West Africa, that is situations in which individual students are challenged to perform. A challenge can be a field trip to meet new and different people, and, of course, a familiar challenge from teachers to students is to perform well on tests, to work hard on completing projects, and to pay attention in class. In short, the challenge in the classroom is to focus attention on completing a task that requires from the students a risk, a performance.

4. FEEDBACK



Effective teaching provides an opportunity to offer feedback to both teacher and students. Traditional feedback has been grades on a test or evaluation of a paper. It can also be a teacher saying to a student, "Yes, that's a good idea". Feedback is a supervising teacher saying to a student teacher, "I liked the way you handled that situation, you've done a good job today". Feedback is extremely important in the learning process. Students want to know about their progress, teachers want to know if their instruction is effective. At times, progress on a lesson cannot be continued until there is feedback.

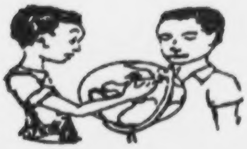
5. INTEGRATING

Effective teaching integrates new information and knowledge with applied practice and performance. Integrate means to unify and unite as in joining together different ethnic groups into one nation. In Environmental Education integration means examining a problem or issue from the perspective of each of the natural sciences, social sciences and humanities. Understanding of the issues, then, comes from the integration of knowledge. No subject should stand alone in the school curriculum because they are all part of the students' whole experience of being educated and functional in his or her environment.

6. MODELING

Effective teaching requires modeling the behaviour the teacher wants the student to practice. Modeling means serving as an example to be imitated. For example, if the teacher wants students to respect other people, exhibit tolerance, be open-minded, then the teacher should expect to model these behaviours. Environmental Education teachers who use problem-solving enquiry approach should model open-minded attitudes, allow freedom to investigate, or practice the skills and attitudes they want their students to have, and encourage that behaviour from students. In short, "Do as I say and as I do".

7. REINFORCING



Effective teaching should build in powerful reinforcement of ideas by repeating the same ideas in different forms of presentation. For example, in a map location exercise the Environmental Education teacher would have a large map of Africa in the front of the room on which he/she would point to Southern Africa: Malawi, Zambia and Botswana. Then each student would have at his/her desk paper on which the student would draw a map of Southern Africa and mark the proper countries. Thus this exercise would have repeated the locations three times, but each time in a different form of presentation. Other examples of reinforcement are giving a test and then using the test, after it has been evaluated, to reinforce in class discussion what should have been learned. Reinforcement could also be having students read a lesson, then students in small groups would identify the important points in the lesson and report those points to the entire class.

8. REWARDING

Effective teaching is rewarding for both teacher and student. Rewarding means a satisfying mutual experience that is shared by both. For example, a teacher who wants to encourage and motivate performance, achievement, and participation sets incentives such as rewards for students to work towards. Rewards are often a visible recognition of success. But material rewarding should be used judiciously in order to avoid the rewards becoming an end in themselves.

9. SELF-DIRECTION

Effective teaching encourages self-direction which means self-management or supervision of one's own learning. One of the purposes of education is to encourage students to set their own goals and to learn how to work toward accomplishing those goals. Self-direction can be encouraged through students planning their own projects, small group work, or in student directed research. Some methods of teaching such as enquiry specifically promote the practice of self-direction where students identify and study several issues and problems.

10. SELF-ESTEEM

Effective teaching sets a climate of warmth and trust and enhances the self-esteem of both teacher and students. In short, self-esteem is pride in oneself. Self-esteem is extremely important because it has to do with students' beliefs about their possibilities of achieving success in the classroom. Studies have shown that students who do not have a good self-image do not perform well in class. Teachers encourage self-esteem by saying such things as, "You are a good student and I know you can do the work", or "This class has done excellent work and I know this quality of work will continue". Classrooms that emphasize a positive attitude where Environmental Education teachers believe students are capable and where students know they can achieve some success are likely to be effective places to learn.

11. SELF-FULFILLING PROPHECY

Effective teaching uses the principle of self-fulfilling prophecy. Prophecy is a prediction. The accomplishments or successes of students will depend on the teacher's treatment and expectations of them. If students are taught as though the teacher thinks they cannot learn, they probably will not learn. If students are told they are in an excellent class that can learn, they are more likely to learn. You become what you think you are, that is a self-fulfilling prophecy. What you think you can do, you probably can do. When students know that teachers believe them to be capable, then it is easier for students to be challenged to a new task.

questioning
Citizen

You can help students' attention and learning if you

- **Set goals for them or help them set their own**
- **Accommodate their learning styles and capabilities**
- **Challenge them to achieve**
- **Provide them with feedback on their progress**
- **Integrate new knowledge with familiar experiences**
- **Model the behaviours you want in your students**
- **Reinforce what has already been learned**
- **Reward achievement**
- **Enhance the self-esteem of your students**
- **Use the principle of self-fulfilling prophecy**

Summary and Conclusion

Good practices that promote learning, remembering and effective teaching are what this methods book is all about. Methods books are written for teachers who are dedicated to developing the best if not the maximum learning from their students.

Studies on learning over the past half century, as summarized in this chapter, are basic to good teaching. It is our challenge to identify promising teaching methods, techniques and strategies and promote communication with students. The summary of research suggests where to start looking for answers.

The application of effective teaching practices will be illustrated mainly in the chapter that follows on methods, techniques, and strategies. Hopefully this has been an important chapter. Many concerns of teachers could be successfully addressed if the effective teaching suggested here was actually put into practice in Environmental Education classrooms.

IMPROVING TEACHING

10% of what we hear
15% of what we see
20% of what we both see and hear
40% of what we discuss with others
80% of what we experience directly or practice
90% of what we attempt to teach others

Reference

Adres, F.T. 1979. Do Answering Higher Level Questions while Reading Facilitate Productive Thinking? *Review of Educational Research,* 49, 280-318.

Armento, B.J., ed. 1986. Research on Teaching Social Studies *Handbook of Research on teaching,* 3rd. edition, ed. M.C. Wittrock, 942-51. New York: Macmillan Publishing Co.

Atwood, V.A., ed. 1986. *Elementary Social Studies: Research as a Guide to Practice*, Bulletin 79. Washington, D.C.: National Council for the Social Studies.

Ausbubel, D., Novak, J., & Hamesian H. 1978. *Educational Psychology: A Cognitive View,* 2nd. edition, New York: Holt, Rinehart & Winston.

Barnes, S. 1981, September. *Synthesis of Selected Research on Teaching Findings*Report 9009). Austin, TX: Research and Development Center for Teacher Education.

Barth, J.L. 1986. A Comparison of Nigerian and Egyptian University Student Responses to the Barth/Shermis Social Studies Preference Scale. *African Social Studies Forum,* 1, 1. 24-32.

Barth, J.L. & Norris, W. 1976. A Study Examining the preference of Teacher Candidates from Different Cultures Towards Social Studies. *Nigeria Educational Forum,* 2, 2, 53-58.

Barth, J.L. & Shermis, S.S. 1980. A Study of Student Teachers Effectiveness in Applying I nquiry Questioning Skills. *Journal of social Studies Research,* 4,2, 34-36.

Bransford, J. 1979. *Human Cognition: Learning, Understanding and Remembering.* Belmont, CA: Wadsworth.

Brophy, J. & Good, T. 1987. Teacher Behaviour and Student Achievement, *Handbook on Research on Teaching*, 3rd edition, M. Wittrock, Ed. Rand McNally.

Clifford, G.j. 1973. A History of the Impact of Research on teaching. *Second Handbook of Research on Teaching.* R. Travers, Ed. Chicago: Rand MacNally.

Ehman, L.H. & Hahn. C.L. 1981. Contributions of Research to Social Studies Education. *The Social Studies*, H. Mehlinger & O.L. Davis, Eds. Chicago: The University of Chicago Press. 60-81.

Frase, L. 1968. Questions as aids to Reading: Some Research and a Theory. *American Educational Research*, 5, 319-322.

Gage, N.L. 1984. What do we Know About Teaching Effectiveness? *Phi Delta Kappa*,66, 87-93.

Herman, W.L. 1969. *Current Research in Elementary School Social Studies.* Toronto, Canada: Collier-Macmillan Ltd.

Hunkins, F.P. ed. 1977. *Review of Research in Social Studies Education: 1970-75.* Washington, D.C. National Council for the Social Studies and Boulder Co: Eric Clearing House for Social Studies/Social Science Education and Social Science Education Consortium. ED 141, 192.

Jantz, R.K. & Klanwiller, K. 1985. Early Childhood Elementary Social Studies: A Review of Research in Social Studies Education: 1976-83. *Review of Research in social Studies Education: 1976-83.* Bulletin 75. W.B. Stanley, Ed. Washington, D.C.: National Council for the Social Studies, 8, 65-121.

Mayer, R. 1979. Twenty Years of Research on Advance Organizers: Assimilation Theory Still the Best Predictor. *Instructional Science*, 8, 133-167.

Massiales, B. & Smith, F. (Eds.). *Current Research in Social Studies*, Bulletin -Indiana University School of Education 14,2 (March 1964).

Medley, D. 1982. Teacher Effectiveness. *Encyclopedia of Educational Research.* H. Mitzel, Ed. New York: Free Press. 1894-1903.

Nelson, J.L. & Shaver, J.P. 1985. On Research in social Education. *Review of Research in Social Studies Education.* Bulletin 75. W.B. Stanley, Ed. Washington D.C.: National Council for the Social Studies. 401-433.

Rosenshine, B.V. 1979. Content, time and direct instruction. *Research on Teaching, Concepts, Findings, and Implications.* P.L. Peterson & H.J. Walberg, Eds. Berkley: McCutcheon.

Stanley, W.B. Ed. 1985. *Review of Research in social Studies: 1976-83.* Washington, D.C.: National Council for the Social Studies.

Tobias, S. 1982. When do instruction methods make a difference? *Educational Researcher*, 11, 4-9.

Wallen, N.E. & Fraenkel, J.R. 1988. An Analysis of Social Studies Research over an Eight Year Period. *Theory and Research in Social Education*, 16, 1-22.

CHAPTER FOUR

ENVIRONMENTAL ISSUES AND PROBLEMS

Introduction

In their interaction with the environment, people have to decide when to use it, how to use it, and to what extent they should do so. They will continue to make such decisions. For this reason, we need to learn more about environmental issues. This knowledge will help us make more informed decisions about the environment. Hence the theme for this chapter.

The main considerations in this chapter include the following:

1. An explanation of the meaning of the terms *environmental issue* and *environmental problem*, and how they relate to each other.
2. Using the topic of *population,* attempts are made to further clarify and illustrate certain population related environmental issues and problems as well as their relationships.
3. Two sample lessons are provided on the problems of soil erosion and desertification in Africa.
4. The last part consists of content on two other major environmental problems, namely, pollution and natural disasters.

Objectives

By the end of this chapter you will be able to:

1. Distinguish an environmental *issue* from an environmental *problem*.
2. List at least five environmental issues and five environmental problems in your country.
3. Identify and list three issues related to population.
4. Describe and explain at least three problems that arise from identified population issues.
5. Suggest remedies to the named environmental problems.
6. Plan and effectively teach lessons on at least two environmental problems.

Definitions

Environmental Issue

A dictionary definition of the noun *issue* says that it is a point in question, or a matter that is in dispute; or a point, matter or dispute, the decision of which is of special or public importance.

Following from these definitions, we can say that;

An environmental issue is any subject about the environment on which we can form different opinions and take various alternative decisions.

Environmental issues arise from our perceptions and the decisions we make during interactions with the environment. For example, if people in a village form no opinions about the river that traverses the village, the river is not an issue. On the other hand, if they begin asking questions and making different suggestions on how the river can be used to enhance the development of their village, then the river becomes *an issue*. If the villagers ask more questions regarding the ecological impact of their alternative plans, then the river is now *an environmental issue*. What then is an environmental problem?

Environmental Problem

An environmental problem may be caused when any activity interferes with, and destructively affects an ecosystem or ecosystems. One example of this is the problem of soil erosion. It may be caused by deforestation, overgrazing, over-cultivation and other unwise land use practices.

Environmental problems may also result from the environment itself. Lightning, hurricanes, earthquakes and volcanic eruptions are a few examples of this type of causes. Their destructive impact is called *natural disaster.*

Two observations can be drawn from the preceding paragraphs. One of them is that environmental issues and problems are related. The other is that the relationship is parental like, where the environmental issue gives rise to the environmental problem. That relationship aside, let us see if we can distinguish environmental issues from problems and vice versa by responding to the activity below.

Activity 1: *Identifying Issues and Problems*

1. The list that follows consists of terms that describe either an environmental *issue* or an environmental *problem.*

2. Show your correct understanding of the two terms by listing each of the terms in the appropriate column in the table below:

a) The list of terms

1. Noise
2. Wildlife conservation
3. Alternative sources of energy
4. Floods
5. Famine
6. Plague
7. Land allocation
8. Air pollution
9. Earthquakes
10. Resettlement of nomadic pastoralist
11. Location of industries
12. Female environmental education
13. Overpopulation
14. Mono-cultural agriculture

b) The Classification Table

ISSUE	PROBLEM

Self-Evaluation

1. **Now how well did you do in the above activity?**
2. **Well, if you listed numbers 2,3,7, 10, 11, and 12 as issues and 1,4,5,6,8,9,13 and 14 as problems, then you performed excellently; you classified all items correctly.**
3. **Those of you who were less successful, please check where you went wrong, and make the necessary corrections.**

Population Issues and Problems

This part of the chapter will attempt to increase further our understanding of environmental issues and problems. This time we shall base our learning on the term *population*.

Issues and problems related to the term population are many and varied. Here we have selected only a few of them to be discussed in the chapter. These are:

1. **Population size**.
   This is the number of people there are in a given location, town, country, etc.

2. **Population distribution**
   The variations in the density of the population in the different parts of the country, for example.

3. **Population structure**
   This refers to the comparative number of children, adults and aged people in, say, a given country.

What makes the above listed concerns issues rather than problems? They are issues

because people can justifiably hold different opinions on each of them. Let us try to verify this suggestion by working through table 4.A.

Table 4.A Selected issues related to population

Issue	Question	Possible Opinions
1. Population Size	**Should our country have a large population?**	**1. Yes. This will help provide cheap labour.** **2. No. Such a population will be too costly for the nation to support.**
2. Population Distribution	**Is it desirable to have densely and sparsely populated areas in a country?**	**Yes. Why?** **No. Why Not?**
3. Population Structure	**Is a large number of children in our population a good thing?**	**Yes. Why?** **No. Why not?**

We stated earlier that environmental issues and environmental problems have a more or less parental relationship. Let us demonstrate this in respect of the issues we have just listed.

The Dynamic Relationship of Issues and Problems.

Issue		***Related Problem***
1. Population size	**1.**	**Inadequate education facilities**
	2.	**Over-crowding**
2. Population distribution	**1.**	**Over-cultivation and over-cropping**
	2.	**Accelerated soil erosion**
3. Population structure	**1.**	**Disproportionately large dependent sections of the population**
	2.	**Excessive economic constraints on the nation**

In our attempt to understand population issues better, there are two important considerations to which we must pay attention in this chapter. These are:

1. Population growth.

2. Population and resources.

These issues are central to and prevalent in people's daily lives, especially in the developing countries. We shall therefore briefly discuss them below.

Population growth

There are many factors that may affect the growth of a population of a given place or country. These may include, for example, migrations, births or deaths. But such factors are not the main concern of this part of the chapter. It will focus on helping you to understand the meaning of the expression *population growth.* Therefore we shall discuss births and deaths as factors that affect population growth. To explain the meaning of birth rate and death rate we have used the example of a Ugandan village called Nsambya.

The Natural Population Increase of Nsambya Village

1. In 1980 the population of Nsambya Village was 1000 people.

2. Between 1980 and 1984 this population grew as follows:

Table 4.B Natural population increase in Nsambya, 1980-84

Year	**Population**	**Total Births**	**Births Rates**	**Total Deaths**	**Natural Increase**
1980	**1000**	**43**	**43 per 1000**	**21**	**22 per 1000**
1981	**1022**	**45**	**44 per 1000**	**20**	**24 per 1000**
1982	**1047**	**42**	**40 per 1000**	**18**	**23 per 1000**
1983	**1051**	**38**	**36 per 1000**	**15**	**22 per 1000**
1984	**1074**	**35**	**32 per 1000**	**12**	**21 per 1000**

3. Note that:

   a) To obtain the birth rate (number of births per 1000) we use the following formula:

   Total births (B) divide by total population (P) multiplied by 1000 i.e.

   $$\frac{B}{P} \times 1000$$

   For Nsambya Village in 1981 this was

   $$\frac{45}{1022} \times 1000 = 44 \text{ per } 1000$$

   b) Death rates are calculated in the same way.

   c) The *natural population increase* is obtained by the following formula:

   (Birth rate minus Death rate) divide by total population x 1000

For Nsambya Village in 1981 this was

$$\frac{(45-20)}{1022} \times 1000 = 24 \text{ per } 1000$$

Let us now give you an opportunity to ensure that you have understood the concepts we have just covered.

Activity 2: Bi*rth rates, Death Rates and Population Growth*

1. Study the figures in the table below.

Table 4.C Hypothetical population figures

Year	**1850**	**1875**	**1900**	**1925**	**1950**	**1975**	**2000**	**2025**	**2050**
Birth Rate	**37**	**36**	**37**	**36**	**30**	**25**	**15**	**18**	**14**
Death Rate	**32**	**38**	**35**	**25**	**15**	**14**	**13**	**10**	**10**
Population	**1000**	**?**	**?**	**?**	**?**	**?**	**?**	**?**	**?**

2. Complete the table by calculating the total population for the years 1875 to 2050.

3. Using the statistics in the table, draw separate graphs for:

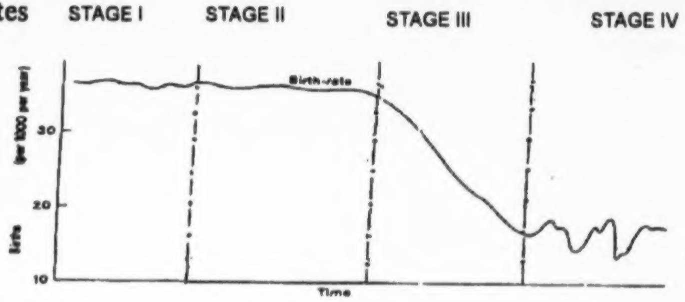
   a) Birth rates
   b) Death rates
   c) Population growth.

4. The three graphs you have produced should look like Graphs A, B and C, in Figure 4.1 below.

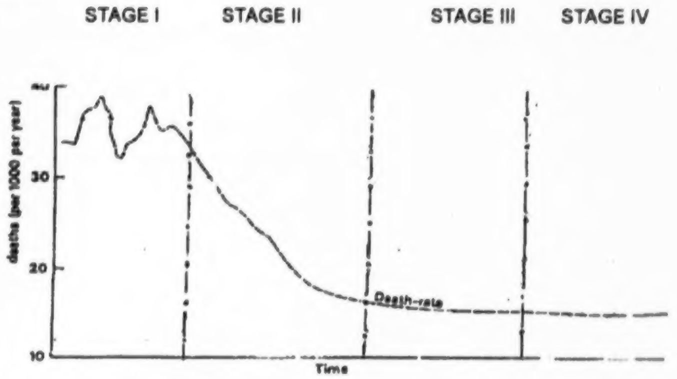
5. In order to generate an integrated picture of the dynamics of population change in this particular country, try to superimpose graphs A, B and C so as to get graph D. What do you now learn from D?

At this point, we would like to summarize some of the major ideas we have explained in respect of birth rates, death rates and population growth. We shall do so by individually filling in the blanks in pencil in the box below. As you do so refer closely to graphs A to D in Figure 4.1.

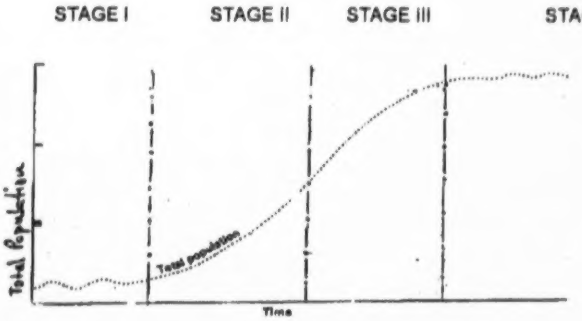
Graph A:
Crude birth Rates
(CBR)



Graph B:
Crude death rates
(CDR)



Graph C:
Population
growth



Graph D. Relationship of population growth to CBR and CDR

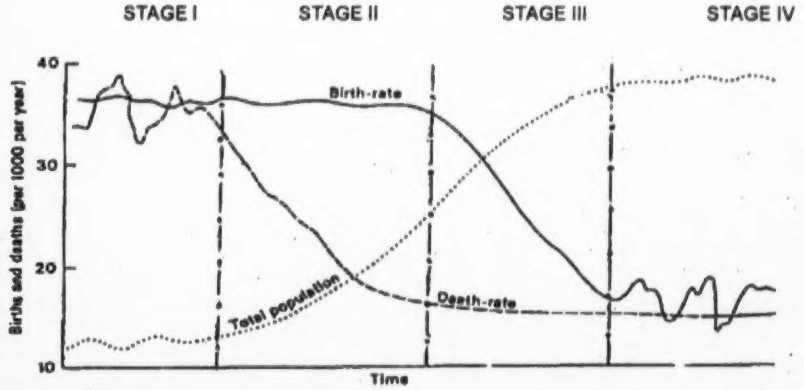


Fig. 4.1 Graphic representations of bith rates, death rates and population growth.

In the first stage, the.................rate tends to fluctuate more than the................rate, but because both rates are high, the population remains fairly............... During the second stage improvements in...................and................lead to a...............death rate, although the birth rate remains............... This produces a rapid..........in the overall population. In stage three the death-rate stabilizes at a.................level, but the birth-rate..............due to improved.............and the use of.................. However, the population continues to............until the beginning of stage...........In this final stage both rates are low, though the birth rates tend to................more. Since the two rates are relatively...................they cancel each other out and the population..............

Missing words increase, birth, four, hygiene, equal, drops, standard of living, high, fluctuate, death, medicine, rise, constant, contraception, low, falling, stabilizes.

Population and Resources

The second important aspect which we want to comment on further is the relationship of population and resources.

The graphs that you have just developed show that when fertility is high, as indicated by high birth rates, population grows rapidly. Very often the resources of the same population do not increase as fast. The quality of life largely depends on a careful balancing of population and resources. Failure to achieve this balance can lead to a decline in a population's quality of life. This is true of a family, a community and a nation.

Let us try to verify the truth of the preceding paragraph. We shall base our verification process on two families, a big and a small one. We shall also proceed systematically using the inquiry procedures.

1. The Inquiry Problem: Which of the families is more manageable, a large one or a small one?
2. Hypothesis: With limited resources, a small family is easier to manage.
3. Testing the hypothesis: We shall use the assignments in the two boxes that follow to address this task.
    a) Do **assignment 1** by completing the paragraph in the first box by filling in the blanks with the correct answers. *Please use a pencil.*
    b) What conclusions do you draw after filling in the missing information?
    c) Now try **assignment 2** in the second box, using a pencil.
    d) After the second assignment, which conclusions have you reached about a large family and a small family?

Assignment 1

Ali has alarge family because he has.......................................(3,8) children. Ahmed has .... (3,8) and his is a ....(large/small) family. In Ali's house..................(little/much) is required to feed all the children, and Ali finds it...........................(difficult/easy) to provide sufficient clothes for the children. Ali finds that the money he earns is............................. (sufficient/insufficient) for him to feed and clothe his children. On the other hand, in Ahmed's house there is ....(enough/not enough) food for the children because Ahmed has...................(few/many) children to feed. The money that he earns appears to be .... (sufficient/insufficient) for him to take care of his family.

Assignment 2

Select the phase you think best completes each statement.
Do so by checking (X) against the appropriate statement.

a) I think that there should be:

- (i) Many children in a family;
- (ii) No children in a family;
- (iii) A few children in a family.

b) Parents can more effectively manage and look after their children in:

- (i) A family with many children;
- (ii) A family with only a few children.

c) If I am a father/mother of a family, I would like to have:

- (i) 1 child only,
- (ii) 2 children,
- (iii) 3 children,
- (iv) 4 children,
- (v) More than 4 children

Sample Lesson 1

Topic: The Problem of Soil Erosion

Objectives

By the end of this lesson the students should be able to:

1. Define soil erosion.
2. State its main causes.
3. Explain the effects of soil erosion on environmental resources.
4. Suggest possible solutions to the problems.

Suggested Learning/Teaching Materials

1. An eroded piece of land in the village preferably near the school
2. Pictures showing different types of erosion - sheet erosion, rill wash and gullies
3. A short text of a case study

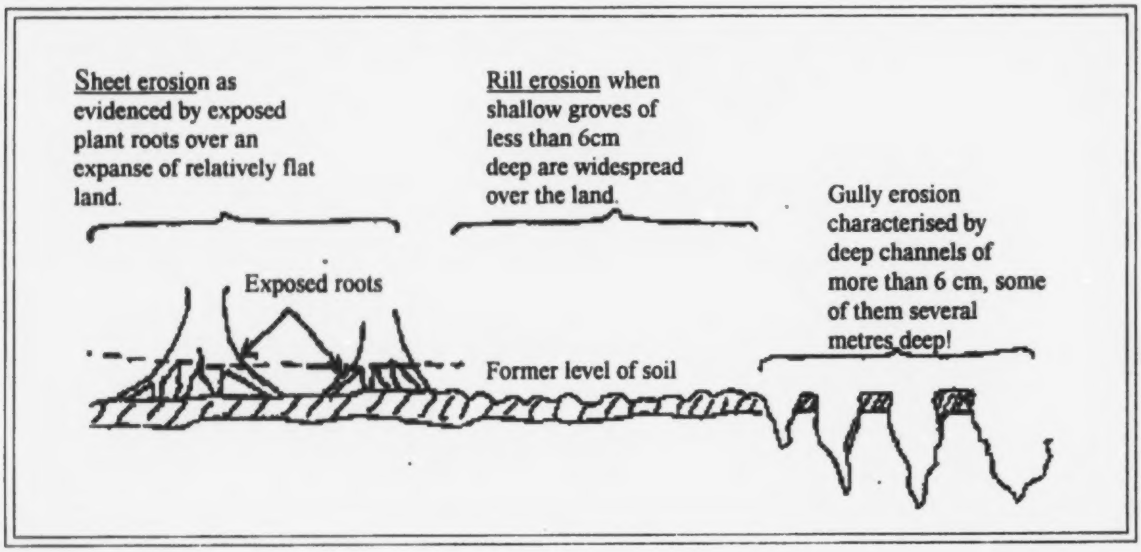

Sheet erosion as evidenced by exposed plant roots over an expanse of relatively flat land.
Rill erosion when shallow groves of less than 6cm deep are widespread over the land.
Gully erosion characterised by deep channels of more than 6 cm, some of them several metres deep!
Exposed roots
Former level of soil

Fig. 4.2 Types of erosion

Procedure

The Definition

1. Have your students look up the term erosion in their dictionaries.
2. Let a couple of them read out the meaning.
3. Summerise the meaning on the board.

Soil Erosion

This is the loss of the top soil when it is carried away by running water or wind. It is a form of soil degradation;it reduces fertility and other good qualities of the soil.

A Brief Local Field Observation

4. Take the learners out for a short field trip preferably near the school and have them critically observe an eroded area.

5. Have the learners carry out the following tasks:

   a) Briefly record the main features of erosion which they observe.

   b) Note down the main causes of erosion.

   c) Mark the eroded parts on sketch maps of the area being observed.

   d) Write short descriptions of their observations, highlighting both problems and possible solutions.

6. After the students return to the classroom, have a general discussion of the field-trip, during which the major points will be highlighted and summarized by team leaders or yourself.

A Case Study

Now with this practical exposure of the learners to the causes and affects of soil erosion in their own local environment, take them on a longer trip, but this time using a Case Study.

7. Have the students carefully read the text below.

SOIL EROSION IN LESOTHO

High mountains are naturally weathered and eroded. Soil particles are then deposited in low-lying areas. Heavy torrential rainfall and steep slopes often accelerate this process in mountains and along slopes or in valleys.

In mountainous countries such as Lesotho and many parts of South Africa, this process has been accelerated. This is because some communities practice subsistence farming using traditional methods, like mono-culture or promoting new growth of grass by veld burning. The hill slopes are used as communal grazing land and are a source of wood fuel.

In the past the villagers sent their cattle, sheep and goats to high pastures in the Drakensberg mountains. This practice allowed village pastures to recover and grasses to seed. In winter, the animals were driven back to the villages to graze on mountain pasture and the stubble in the fields. To maintain soil fertility, farmers left some of the land fallow so that it would recover.

Presently, the population of the village has increased and most families want to own animals. The land has been sub-divided into smaller plots which are no longer enough to feed the villagers. To increase the cultivatable area, steep slopes are being cultivated. Another result is that more than half of the adult male population in the village goes to the mines to bring the much needed cash and to buy more animals.

Farmers use no manure on their fields and the cow dung and the maize stalks which could provide manure are used as fuel. The practice of planting one crop on a field from year to year has led to loss of soil structure and fertility. Failure to practice fallowing, due to shortage of arable land has accelerated the process. In spring (August to October) strong winds blow. They erode fine particles of the top soil. The first spring rains carry off more soil from the exposed steep slopes.

In the end most of the top soil has been washed away and heavy surface run off, due to lack of vegetation cover. This has resulted in many rills which are enlarged every year to form gullies. Lack of vegetation cover with the resultant heavy surface run off, has reduced seepage into the ground. The local streams and a stream nearby, run only after heavy rains. This has caused a shortage of drinking water. Small dams for watering animals and the stream beds are filled with sediments brought by surface run off.

Soil degradation is an old problem in the village but farmers do nothing to stop devegetation and soil loss. This may be partly because they lack understanding of the local ecosystem and also because they do not own the land they use. The government sends extension officers to the village to demonstrate better methods of farming such as contour ploughing, maintaining contour ploughing and contour strips as well as making contour farrows. Farmers also get subsidies to buy fertilizers and to plant winter crops in order to provide soil cover. They are also encouraged to grow fodder crops so that their animals do not depend on the depleted grazing pastures. Farmers are encouraged to improve their stock through artificial insemination programmes. To reduce over-stocking they practice rotational grazing on the limited village pastures. Villagers are no longer allowed to import cattle. Very few farmers follow this advice because traditionally a man's wealth is measured by the number of cattle he owns.

Evaluation

When students have read this case study they will answer the following questions:

1- According to this case study, what are the causes of soil erosion?
2- Explain in writing how removal of vegetation increases soil erosion.
3- Which type of erosion is the most demanding to the environment? Why?
4- Describe four different ways in which your community can undertake or is undertaking to solve the problem of soil erosion.
5- Name four results of erosion in the area of the case study.

Conclusion

In this case study, we have learned how the natural process of soil erosion is accelerated by people. Overstocking the pastures and traditional practices of veld burning to promote new growth destroys vegetation cover and the exposed soil is carried away by wind and rain run-off. Due to pressure of population on land, traditional ways of recovering fertility are not possible and mono-culture and other poor farming practices have added further to soil degradation. What took nature millions of years to perfect, people have destroyed in a few decades and the land may take another million years to recover fully.

Sample Lesson 2: The Problem of Desertification in Africa

Introduction

In this study you are going to learn about the causes, effects and possible solutions to desertification. When vegetation is destroyed, the soil is exposed, making it easy for wind and water to carry it away. Plants do not grow well in the poor soil that is left behind. As a result, they die, leaving more and more land bare. This soil degradation marks the beginning of desertification.

Objectives

By the end of this lesson you should be able to:

a) Define desertification.
b) Describe at least three causes of desertification.
c) Describe at least three major effects of desertification.
d) Describe at least three possible solutions to desertification.
e) Draw a chart showing the main stages in desertification.

Meaning of Desertification

Desertification is the process by which land is made barren. For example, in arid and semi-arid regions where communities cut down trees for fuel without replacing them, areas of land are left bare and the top soil is exposed to erosion. When this happens, there is loss of fertility and reduced water supply.

Activity 3 *Desertification in Africa*

This activity is meant to facilitate the study of the extent of the desertification problem in Africa and to increase the learner's awareness of this problem.

Resources

1. A political wall map of Africa
2. An African map of desertification (Fig. 4.3)

Procedure

1. Study the two maps.
2. Using the information from the two maps, complete the table below by filling in the columns the missing information. Select your terms from the following:

   a) Regions: Northern Central Western
   Southern Eastern

   b) State of Desertification: Moderate, Severe, Very Severe

3. Use the maps to name other countries affected by desertification, indicating the level of seriousness of this desertification (i.e. Moderate, Severe, Very Severe).

Country	**Region**	**State of Desertification**
1. Niger (Example)	Northern	Severe
2. Mali		
3. Bourkina Fasso		
4. Senegal		
5. Chad		
6. Mauritania		
7. The Gambia		
8. Ethiopia		
9. Somalia		
10. Kenya		
11. Tanzania		
12. Uganda		
13. Botswana		

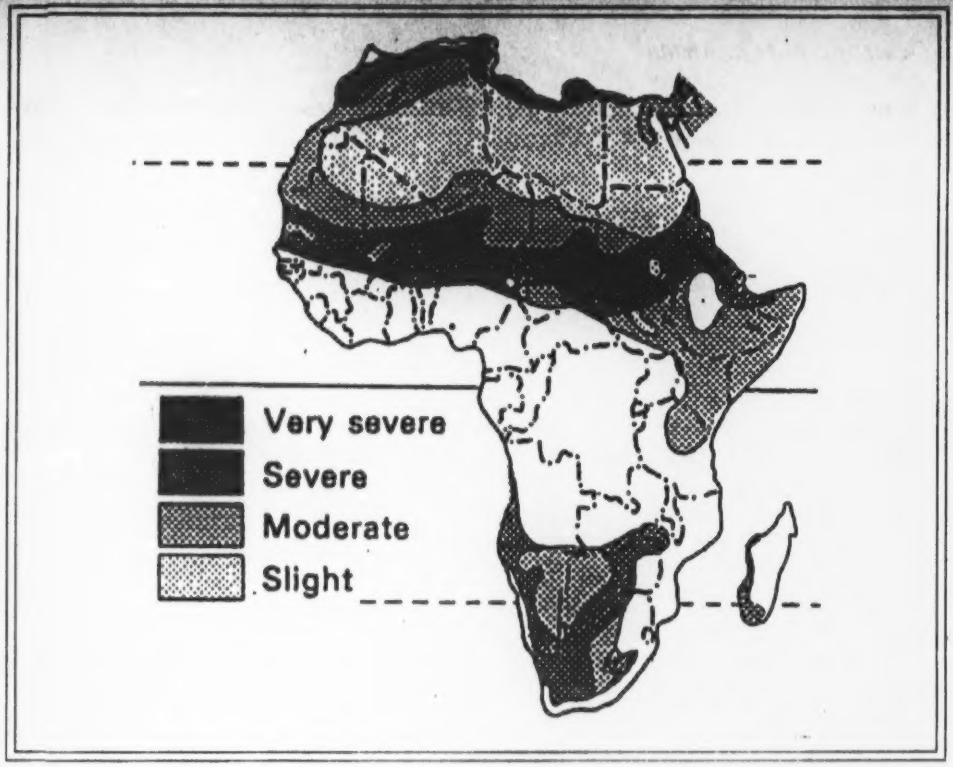


Fig. 4.3 Desertification in Africa

4. Orally ask the class the following questions.

   a) Which are the most desertified regions in Africa?

   b) What should the countries in a given region do together so as to combat desertification?

5. Now task each student to write a paragraph on any local organisation in their country whose activities are directed towards fighting the spread of deserts.

Desertification: Causes, effects and possible remedies

6. Introduce the three main causes of desertification. These are:

a) Devegetation
b) Overgrazing
c) Over-cultivation

These activities are a result of having too many people and livestock on the land; thus over-using a delicate ecosystem. Such a system is that kind of land which has a very low carrying capacity or whose natural balance can easily be upset. Examples of these ecosystems are rangelands with low rainfall and sparsely growing grasses.

7. Through well planned questioning and discussion with the class, elicit from the learners some detailed information about the nature, effects and possible remedies to desertification. Try to generate facts along the lines of the three boxes below.

Overgrasing

Overgrazing mainly takes place in the arid and semi-arid lands when pastoral societies overstock. The **overstocking** is due to a variety of factors, such as the following:

a) Population growth among people who depend heavily on animals means that the animals must be increased;

b) Nomads who have moved to towns have sent money back home to increase the family herds as an investment;

c) Improved veterinary care has lowered the death rate of animals;

d) Provision of many boreholes has allowed more animals to be watered, that is more than the rangeland vegetation can feed in drought periods, and

e) Land settlement has encouraged the encroachment of rangelands by agriculturalists who have not only increased the demand for land, but also have introduced unsuitable land use practices, like the growing of crops such as maize, beans, potatoes on otherwise pastoral land. Overgrazing exposes the land to soil erosion, loss of productivity and desert like conditions.

The problem of overgrazing can be solved by a number of measures. Among these are the following:

a) Controlling the size of the herd. This is normally difficult unless the human population is controlled first and the traditional attitudes are changed.

b) Selective breeding might improve the herd so that each family keeps only a few good, productive animals, which again would need changes in traditional attitudes.

Over-cultivation

This is sometimes referred to as **over-cropping**. It means growing crops well above the level that the land can support. Rainfed agriculture in the arid and semi-arid lands is very delicate. It does well only in areas of over 500 mm of annual rainfall. Areas with less than 750 mm of rainfall must maintain a fallow system so as not to exhaust the soil. However, while population continually grows, the land does not expand. This fact leads to three consequences.

a) Farrow periods are being shortened.

b) Farmers are forced to extend outwards from rainfed agriculture areas to drier areas of pastoral lands. They till soil which is too delicate and arid to be permanently cropped. Such soil will only remain productive if covered with permanent grass. The result is that the soil becomes drier, dustier and sandier, and thus gets easily blown away by wind. Crop yields fall, and even the naturally growing grass have difficulty in re-establishing their growth.

c) More people need more fuel for cooking and, as a result, more naturally growing trees and bushes are cut down and seldom replaced by planting seedlings. This is often the first stage of desertification.

The process of desertification which results from these difficulties takes place in stages. This is illustrated in Figure 4.5.

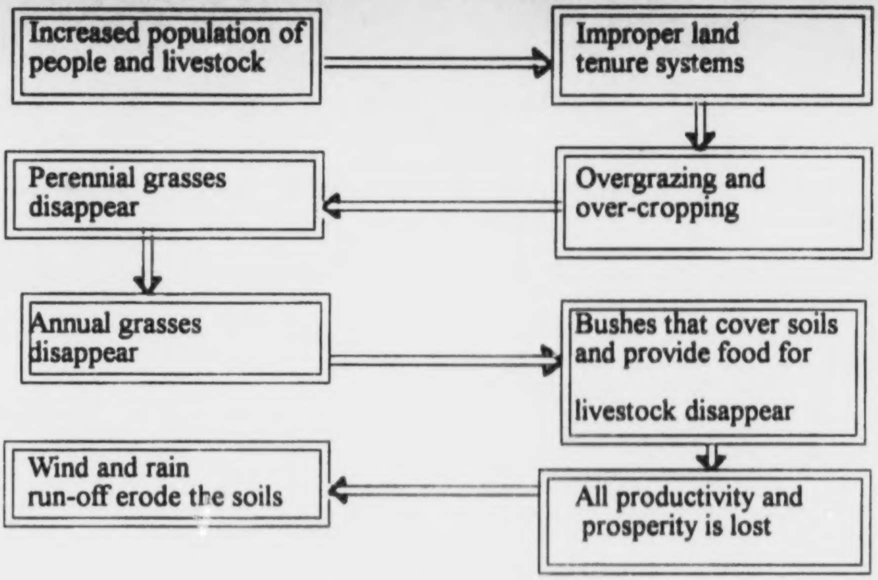

Increased population of people and livestock
Improper land tenure systems
Overgrazing and over-cropping
Perennial grasses disappear
Annual grasses disappear
Bushes that cover soils and provide food for livestock disappear
All productivity and prosperity is lost
Wind and rain run-off erode the soils

Fig. 4.4: The process of desertification in Kenya's arid and semi-arid lands

Evaluation

Have the class take an objective test which will monitor progress made by the learners towards the five instructional objectives stipulated at the beginning of the lesson.

The two sample lessons given in this chapter are intended to assist you to effectively plan and teach environmental problems. The lessons can be utilised, with appropriate variations, in teaching a variety of environmental problems.

You and your class can contribute to the fight against desertification by practicing simple measures to conserve water and soil.

The remaining part of this chapter consists of content on some additional leading environmental problems in Africa. You will need that content as you plan your teaching.

The Problem of Pollution

Our countries are experiencing increasing pollution problems. This is mainly due to recent industrialization, the rapid growth of cities, changes in agriculture technology, and increased population densities.

When waste materials are released into the air, dumped on land or discharged into water, such as lakes, streams, or sea, they pollute the environment. As the waste products released are often too large in quantities to be absorbed or broken down, they rapidly accumulate.

However, waste can be purified and used again. This is called recycling, and it reduces the amount of waste to be thrown away. It also reduces over-exploitation of natural resources for the manufacturing process. Examples of such waste are used metal, plastics, glass, paper, rubber, textiles and chemicals.

Pollution is an environmental problem of concern because of the damage it causes to the environment itself and to people's health. Some of this damage can be summarized as follows:

1. Damage to the *natural environment:* This affects vegetation, animals, crops, soil and water and therefore the people themselves.

2. Damage to *human health:* Caused by specific chemical substances present in air, food, water and radiation.

3. Damage to the *aesthetic quality or beauty of the environment*: Caused by smoke, chemical fumes, dust, noise, dumping of waste and rubbish, as well as abandoned ruins.

4. Damage caused by *long time pollution effects*: These are not immediately seen or felt. This is because the pollution is absorbed into the body over a long period of time, through, for example, smoking of nicotine, excessive noise, drinking of alcohol, and radiation and drug abuse.

Pollution itself is of several types, takes many forms, has varied sources and its effects are numerous. Table 4.D illustrates this point well. Study it carefully.

Because of the extent to which pollution can go and the damage it can cause, it must be effectively controlled by designing and implementing action at all levels. Some of these actions are suggested in Table 4.E on page 59.

The Problem of Natural Disasters

What is a natural disaster?

A natural disaster is a large scale or sudden natural event or process causing suffering, loss of life, damage to property and in the long run, economic loss to the people concerned.

Natural disasters occur when these calamities like lightning, floods, droughts, earthquakes, landslides and pest invasions occur in inhabited areas, and their impact is often felt by the whole country or region.

Here we shall address three types of natural disasters. The are lighting, flood and drought.

Lightning

Lightning is an electrical discharge which is visible in the form of flash. It may occur within a single cloud, or from one cloud to another, or from a cloud to the ground. It is usually followed by a thunder which is a very loud explosive noise in the skies. The rain showers during which lightning and thunder occur are called *thunderstoms*. Some of the damage caused by lightning is summarized on the next page.

1. *Damage to Property*: - Houses are burnt down because of the heating effect;
- Displaces objectives because of pressure, and
- Interruption of electricity supply.

2. *Destruction of trees*:-A tree can be set on fire or split due to the steam pressure set up as electricity passes through its internal fluids.

3. *Health problems and Loss of Life:*- Burns/shocks because of heat.

4. *Natural Fires Occur*:- Lightning can cause fires that burn vegetation.

Since lightning is a danger to life, it is important for your class to know how to protect themselves and others against it. The following hints are useful knowledge about lightning.

1. **Lightning takes the shortest path between a charged cloud and the ground.**

THEREFORE

2. **It is more likely to strike the following:**

   -A hill rather than a valley;
   -A tree rather than bushes, and
   -A tall building rather than a low one.

3. **The most dangerous times for lightning are:**

   -Before and just after it stops raining, and
   -Before and just after the rainy season.

You should also take steps that reduce the risk of exposure to lightning. These are highlighted on page 60.

Table 4.D A summary of pollution problems

Type	Pollutants	Source	Effects and Actual Examples
1. Atmospheric Pollution	1. Gaseous wastes such as Carbon Monoxide, Nitrogen Oxide, Sulphur Oxide, etc	1. Traffic such as all motor vehicles, aircrafts and motor boats;	1. Respiratory ailments like influenza, colds, coughing, short breath, bronchitis and emphysema (especially in urban areas like Zambia copper belt).
	2. Particulates, (suspended solids)	2. Industrial plants like copper mines (Zambia) or wastes such as cement quarries, and	2. Dust reduces visibility (through smog, fog) and can infect lungs.
	3. Dust or soot	3. Mining (especially graving) industries. Domestic heating	3. Death of fish in lakes due to acid rain.
			4. Damage to plant foliage caused by paper mill, oil refineries.
			5. Corrosion of material like of metals and buildings, and
			6. Excessive carbon dioxide which changes the balance of heating in our atmosphere and damages the ozone layer.
2. Noise Pollution.	4. Loud irritating continuous or sudden noise.	4. Traffic like cars, buses, jet aircrafts	7. Noise impares hearing; the damage may be partial ('disco ear') or complete (deafness).
		5. Industrial and construction machines	8. Increases stress in person, causes dizziness and fatigue.
		6. Loud music in recreational places such as discos and bars, in public transport vehicles and loudly tuned Walkman cassette players.	9. Leads to psychological effects and disorders, and may make a person nervous, irritable and 'jumpy'.

Types	Pollutants	Sources	Effect and Actual Examples
3. Water pollution (Affects rivers, lakes, and oceans).	5. Liquid wastes like raw sewage, effluent, detergents, chemicals like heavy metals and pesticides from industry and agriculture. 6. Excessive fertilizers especially nitrates, phosphates. 7. Pesticides.	8. Domestic waste. 9. Storm/rain water which washes pollutants on the land into the rivers and lakes. 10. Careless industrial waste disposal. 11.-Agricultural wastes; -Polluted rivers such as river Nzoia in Kenya. 12.-Oil from leakage of oil tankers, cleaning of ships, -Silt carried from inland by rivers.	10. Waterborne diseases, such as typhoid, and cholera. 11. Surface and underground waters are contaminated. For example, Nairobi river is characterized by scum, grease, dirt, disease germs. 12. Dead fish where the pollution is great. 13. Mercury poisoning through eating contaminated fish. 14. Eutrophication i.e. rich growth of aquatic vegetation of algae as in L. Naivasha (Kenya) and Kariba (Zimbabwe). This kills life; affects fishing as an economical activity like in Lake Naivasha. 15. Eutrophication also lowers the quality of beaches-oil is unsightly, attaches itself to feet of people, kills fish, corals shells and birds by making their feathers sticky and non-water proof. - Muddy water kills the live coral and marine wildlife and leads to absence of fish, such as near Malindi, and - Reduces the continental shelf, and thus the fishing potential of the area.

4. Land Pollution	8. Solid waste like paper, rubber, glass, bottles, and plastic, (non-bio-degradable) and 9. Pesticides, such as D.D.T. Malathion, etc.	13. Domestic/household wastes 14. Organic waste 15. Agricultural Activities.	16.-Unsightly, dirty and smelling environments of waste tips. -Large rubbish heaps in residential estates/areas like in any of the cities/ towns in the region, such as Kampala and Nairobi; -A nuisance to residents such as rubbish dumps and -Uncollected garbage heaps are the breeding places for diseases, germs and vermin which spread them, such as rats, flies and cockroaches. 17- Eventually kills aquatic life generally when washed by rain into the water systems. - Affects birds of prey like eagles, who feed on rats, and - Affects people. For example, the people of coffee growing areas of East Africa, who spray are at risk.

Key Words to define

-Smog

-bio-degradable

-non bio-degradable

Table 4.E: **Practical strategies to the control of pollution**

: **Practical strategies to the control of pollution**

Levels of Action	Types of Action
1. Individual and family	a) Reduce smoking or burning. b) Use fuel efficient stoves. c) Avoid the contamination of any water source. d) Use latrines well and locate them properly. e) Read and follow directions in the use of chemicals in the homes and at work. f) Use chemicals only when necessary. g) Place litter like paper, pencil sharpenings, cans and discarded food containers, sweet wrappers in proper containers. h) Spray pests only when necessary. i) Use ecologically based farming as far as possible. j) Reduce volumes of noise at quiet times like when people are sleeping.
2. Local Community	a) Plant trees and take care of them. b) Keep compounds clean. c) Organise safe and sanitary disposal of wastes. d) Build proper latrines and educate people on their use. e) Maintain safe sources of drinking water. f) Use clean containers for drinking water. g) Control emission of poisonous gases.
3. National Level	a) Enact legistration like 'Traffic Act'; 'No Smoking in Public Places' and Pest Control Products Act' and ensure enforcement. b) Encourage alternative sources of fuel, such as biogas/ gasohol. c) Promote recycling of products such as glass, cans, and wastes. d) Monitor pollution and adhere to standards of, for example, water and food quality. e) Follow a policy of substitution where necessary like using plastics. f) Promote research by say, Government Chemists, Universities, etc.
4. Regional Level	a) Monitor and enforce pollution control like marine pollution off the coast of Eastern and Southern Africa (ESAR) or Lake Victoria. b) Supervise and implement the regional seas programme along the Southern and Eastern African Coast of the Indian Ocean.
5. International Level	Support the major international initiatives in the control of pollution, such as Global Environmental Monitoring Systems (GEMS) and Sub-Regional Environmental Groups (SREGS).

1. **Read more about lightning.**
2. **Be indoors during thunderstorms.**
3. **Avoid standing in rainwater during thunderstorms.**
4. **If caught out in a thunderstorm it is safer to lie down to reduce your height.**
5. **Do not stand under a tree during a thunderstorm.**
6. **Avoid climbing hills during a thunderstorm.**
7. **Stay inside a car or a bus with closed windows during a thunderstorm.**
8. **Tall buildings should be fitted with lightning arresters. These are special rods wired to the ground.**
9. **Do not plant trees too close (less than 12 metres) to the house.**
10. **Cut all low branches of trees that are near the house.**

Floods

A flood is a condition where excessively large quantities of water cover areas that are normally dry and used by people.

Floods are mostly associated with:

- very heavy rainfall,
- heavy snow falls,
- excessive river discharge,
- very high tides and storms at sea and
- breached dams.

Flooding mostly affects low lying areas and plains. The relative flatness of land in such areas makes it difficult for water to drain away quickly. However, the danger of flooding is greatly increased by devegetation, as the flow-chart below explains.

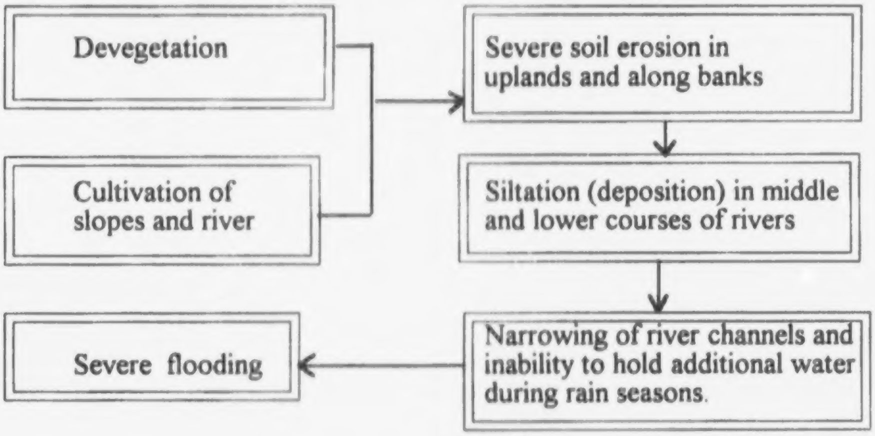

Devegetation
Cultivation of slopes and river
Severe soil erosion in uplands and along banks
Siltation (deposition) in middle and lower courses of rivers
Narrowing of river channels and inability to hold additional water during rain seasons.
Severe flooding

Figure 4.5 How devegetation leads to river flooding

The following measures can be taken by the students themselves, communities, government and other institutions to reduce the effects of floods:

1. **Reduce concentrated run-off by maintaining vegetation cover especially in the catchment areas.**
2. **Communities can create storage basins or reservoirs - to hold water temporarily.**
3. **They should build barrages to hold water until it can be directed downstream.**
4. **Local authorities and governments may dredge and deepen the valleys or channels to facilitate accommodation of increased volume of water during rainy seasons.**
5. **Governments should encourage multi-purpose projects which combine the production of H.E.P and irrigation along major rivers.**
6. **All efforts are needed to educate people in flood-prone areas about floods, the frequency with which they can occur and how to minimize damage from them.**

Drought

Drought is a continuous period of dry weather. The term has been used to describe a wide range of conditions. *Permanent drought* exists when precipitation is always inadequate for plant, human and animal needs. Variations from year to year cause *contingent drought* while seasonal variations may cause *seasonal drought. Invisible drought* occurs when precipitation is just inadequate month by month, resulting in continuous low yields.

It must be pointed out that the core of the drought conditions is moisture deficiency, that is, shortage of water. The amount and period of deficiency can vary. In terms of the water balance in any area, drought occurs when *precipitation,* especially rain, is far less than *evapo-transpiration, run-off* and *seepage.*

CASE STUDY: DROUGHT IN MOZAMBIQUE

By the end of this case study the learners will be able to:-

1. Describe the environmental issues in involved.
2. Describe the environmental problems it covers.
3. Explain the causes of drought.
4. Explain the effects of drought on vegetation, crops, livestock, water resources and land, as well as on the values, laws, and attitudes of people in drought stricken areas.
5. Suggest possible solutions to environmental problems caused by drought.
6. Demonstrate decision making skills in dealing with environmental issues and problems.

What is Drought?

Drought can be defined as a condition where there is less rain than normal. Across Africa, particularly in the semi-arid and sub-humid areas, the rainy seasons are only a few months long. When little rain falls over a long period it may result into a drought.

Drought has in the past affected countries such as Niger, Mali, Burkina Fasso, Senegal, Chad, Ethiopia, Somalia, Kenya, Tanzania, The Gambia, Botswana, Zambia, Zimbabwe, Lesotho, Swaziland and South Africa.

Fig. 4.8 Rainfall in Mozambique over a ten year period

Drought is largely a natural phenomenon. At certain times there is more rainfall while at other times much less rainfall is evident. This happens because of climatic changes and is intensified by certain human activities.

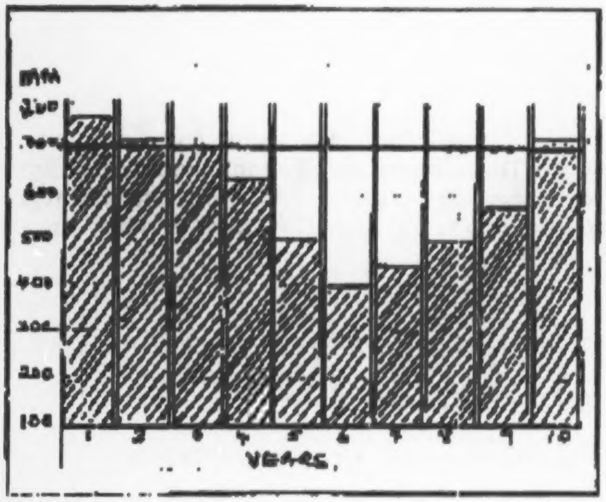


Fig. 4.8: Rainfall in Mozambique over a ten year period

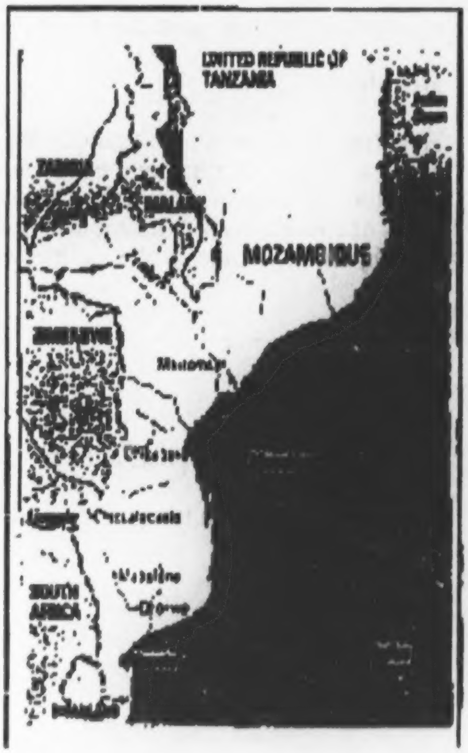


Fig.4.7: Mozambique's rivers

Mozambique

All over Mozambique people have suffered the worst drought in the 20th century. The once full flowing rivers have turned into wide highways of sand. Almost a third of the population have had to leave their homes in search of food and water. In May 1992, the Mozambican government put its first official figure of drought deaths at 48 people in the central province of Sofala. There is a strong possibility of the figure being higher. The United Nations and other international organizations announced that more than three million people were in need of emergency relief. In some cases water is brought by train from neighboring Zimbabwe mostly in Chicualacuala and Chokwe districts.

Crops

Crops have been lost and there has been much evaporation of water resources. Flying over the Limpopo river, one of the longest rivers in Southern Africa, one can see the devastating effect of drought. People can be seen digging along the river bed; the small amount of water they find cannot last long.

In Chicualacuala no drought resistant crops are grown. This has resulted in people eating wild roots and shrubs which are bitter and unfit for human consumption. In the district of Chokwe, production of rice fell from 30,000 to 6,000 tonnes. This was caused by the absence of rainfall, resulting in the decline of the water level in the Massingir Dam.

Possible Solutions

To address the problems that drought brings, the following may be done.

- Development and planting of drought resistant crop varieties
- Construction of reservoirs to store water for irrigation
- Watering crops at night when less evaporation takes place
- Construction of grain silos

Health

Health authorities in Mozambique say the water is unsafe for human consumption and can cause cholera. Many deaths have been caused by it. The villagers are ignorant about the causes and symptoms or treatment of cholera. Between November 1991 and June, 1992 there were 9263 reported cases of cholera in six Mozambican provinces, resulting in 140 deaths. According to the Ministry of Health, almost a third of the victims were from Gaza alone.

POSSIBLE SOLUTIONS

- People should be educated about causes and symptoms of cholera.
- Building of local health clinics.

CHAPTER FIVE

METHODS, TECHNIQUES AND STRATEGIES FOR TEACHING ENVIRONMENTAL EDUCATION

Introduction

The terms 'method', 'technique' and 'strategy' are often loosely used by teachers to mean 'ways of teaching'. These words refer to different though related activities. This chapter will try to clarify the meaning of each of these terms and the relationship among the three of them.

Like chapter two, this chapter is primarily addressed to you as a teacher. Its contents will also be useful to students of in-service and pre-service teacher education programmes. However, you will find some of the activities in it teachable to your classes.

Objectives

By working through this chapter, you should be able to:

1. State the difference between methods, techniques and strategy in teaching.
2. Apply varied methods in lesson planning and teaching.
3. Vary your techniques during teaching.
4. List the advantages and disadvantages of commonly used techniques.
5. Select techniques that are suitable to different teaching situations, and
6. Plan a lesson providing for use of a variety of techniques.

Methods, Techniques And Strategies

What is a teaching method?

A method is the way a teacher decides students will learn. It is a general approach to teaching, which involves a choice between whether learners will mainly be told or they will largely find out for themselves. That is why it is often suggested that there are *two general methods.* If the teacher or the book mainly provides the class with what they have to learn, then teaching is using the *transmission* method. This means content, skills and attitudes are largely handed down to the learners. Thus the class is learning passively.

On the hand, if the teacher or a teaching resource requires students to think about questions or problems and try to work out the answers or solutions, that teacher or resource is using the *problem solving* method. In other words the method is largely concerned with the learners in facilitating student examining, investigating and exploring content, skills and attitudes by the teachers.

Let us give some examples. Some teachers mostly lecture, dictate notes, have recitations or make the students copy notes direct from textbooks for learning. These teachers favour the transmission method. There are also teachers who prefer that their students use the inquiry process to arrive at answers; these favour the discovery or problem solving method.

- **A method of teaching is a general approach to conducting a lesson.**
- **The transmission method is expository and the teacher largely provides the information.**
- **In the problem solving method the students search for answers and information.**

What is a teaching technique?

In order to implement the method that you choose to use in your teaching, you need specific actions. You may lecture, ask the students to role play a situation, conduct a field study or conduct group discussions, and so on. These specific actions and processes through which the teaching method is realised are called *teaching techniques.*

Now let us demonstrate the relationship of method and technique using the dialogues that follows.

An Exchange of Views on Method and Techniques

Dialogue 1

Headmistress: How do you *intend* to facilitate learning by your class?

Teacher: I intend to make them find out for themselves, and so I will use the discovery method.

Headmistress: What will you *do* in class to enable them to discover?

Teacher: I will achieve the method by using the simulation and panel discussion techniques.

Dialogue 2

Headmaster: How do you intend to teach about this topic?

Teacher: I will cover the chapter by presenting a summary of its content (transmission).

Headmaster: Specifically, what would you do to cover the chapter?

Teacher: By techniques of lecture and summary notes handouts.

Diagramatically, the essence of the two dialogues above can be represented as below.

Method->	**Technique ->**
Method is the approach to instruction of facts, concepts, generalizations	Technique is an activity performed to achieve the method
1. Transmission method or	1. Lecture, recitation, discussion
2. Problem solving method	2. Grouping, debate, panel, discussion, oral report.

Fig. 5.1: Relationship of method and technique

Assume the method is problem-solving; techniques to achieve that method might call for student participation in projects, grouping, role-playing, or simulation. If the method is transmission, then the techniques might be lecturing and recitation. Another way of expressing the relationship between method and technique is to ask the question. What do you want to do, what is your intent?" Answer, "I want to cover the subject matter in the chapter (transmission method)". Question: "Specifically how are you going to go over the chapter?" Answer, "By the techniques of lecture and recitation". Now I know your method which is transmission and your techniques which are lecture and recitation.

What Is a Teaching Strategy?

Strategy is simply the *sequencing* or *ordering* of the techniques a teacher has selected to teach the lesson. Increasingly, teachers talk about strategies, a term popularized by the military which suggests the plan of winning a battle— in this case the classroom. How does strategy relate to method and technique? Very simply, strategy refers to sequencing or organising a given selection of techniques.

For example, if one were to select such teaching techniques as introductory lecture, grouping, and panel discussion, these techniques sequenced one after the other are called a strategy. This implies that there is an appropriate ordering of the techniques. Suppose the panel discussion depends upon a grouping of students and a lecture, then the proper sequencing of the techniques to achieve the transmission of content would be (1) lecture, (2) grouping, and (3) panel discussion. (See Figure 5.2).

TECHNIQUE is an activity performed to achieve the method.	*STRATEGY* is techniques sequenced to achieve the method.	
lecture recitation discussion workbook exercise teaching aids grouping debate panel discussion oral report.	*lecture* then *discussion* then *workbook exercise* or *field experience* then *projects* then *written/oral reports*	Sequenced to achieve the method of transmission Sequenced to achieve the method of problem-solving

Fig. 5.2: Relationship of technique and strategy

- **Variety in teaching techniques increases the chances of reaching more students.**
- **At least two or three different techniques need to be used in a lesson.**
- **Method, techniques and strategies mean differently although they are all part of planning to teach.**

Relationship of Method, Technique and Strategy

If teachers use one or two techniques, they should be prepared to face students who are silent, passive, bored, and unco-operative. If, however, you wish to reach a greater number of students, be prepared to plan a strategy using 2-3 techniques depending on the length of the lesson. No one can tell you what techniques you must use. It is important that whatever techniques you select, it should emphasize active participation because this is what research suggests. Please understand this: any given technique may be either passive or active. For example, lecture, grouping, oral reports, field trips, debates, panel discussions, or simulations may be either active or passive, depending on whether students are focused and spend quality time on the lesson. Teaching Environmental Education starts with research on effective teaching practices, but ends with the practical application of the different methods, techniques, and strategies. To understand how techniques and strategies are related to method, see Figure 5.3 and read the dialogue between Mrs. Opolot and her student, Byaruhanga.

METHOD is the approach to instruction of facts, concepts, generalizations	*TECHNIQUE* is an activity performed to achieve the method	*STRAGEGY* is techniques sequenced to achieve the method	
1. Transmission method. or 2. Problem-solving method.	lecture recitation discussion workbook exercise teaching aids grouping debate panel discussion oral report	*lecture* then *discussion* then *workbook exercise* or *field experience* then *projects* then *written/oral* reports	Sequenced to achieve the method of transmission Sequenced to achieve the method of problem-solving

Fig. 5.3: Relationship of method, technique and strategy

Byaruhanga: Excuse me, Mrs. Opolot, would you be kind to spare a moment or two? I think I need your help to clear what I think is some confusion in my mind about teaching.

Mrs. Opolot: Well, you know it is my duty, so I'll be glad to answer your questions.

Byaruhanga: I had an argument with Babirye about an hour ago. I told her that a strategy can be either a method or a technique; that is how it all started.

Mrs. Opolot: What did she think of your view?

Byaruhanga: She said I was confused. Not very kind words, are they, madam?

Mrs. Opolot: Do you realize that you just admitted confusion yourself a moment ago? Anyway, what else did she say?

Byaruhanga: You see, madam, I did not like her attitude. I told her that, and we briefly argued about my statement and other things.

Mrs. Opolot: Perhaps if you had listened some more she might have helped you. She was right in her reference to confusion.

Byaruhanga: Why, Madam?

Mrs. Opolot: First of all do the terms *method* and *technique* mean the same?

Byaruhanga: I know they don't

Mrs. Opolot: But that is what you imply when you say that "strategy can be either a method or a technique".

Byaruhanga: I didn't realize that! What does strategy mean?

Mrs. Opolot: Think of our lesson of yesterday. How did I conduct it?

Byaruhanga: You introduced it; that is, you lectured for... well ... five minutes, was it?

Mrs. Opolot: Never mind the time allocation. Just go on.

Byaruhanga: We performed an experiment, discussed the results in small groups; Babirye read a short text book paragraph and then you asked us oral questions before we recorded the conclusion to the experiment.

Mrs. Opolot: Those are the techniques I used.

Byaruhanga: Madam, I don't understand.

Mrs. Opolot: In order to attain the objectives of my lesson, I chose a method, which was *discovery;* I selected the techniques that I considered appropriate; then I sequenced the techniques in a way that I considered logical and capable of ensuring a smooth flow of dialogue between me and my students and among themselves. That was my *strategy.*

Byaruhanga: That is quite clear and I am grateful, madam.

Mrs. Opolot: No, I am not through with you yet.

Byaruhanga: It is not something wrong that I did, is it?

Mrs. Opolot: In a way it is. The way you conducted your campaign for election to the student council. How did you campaign?

Byaruhanga: I posted my posters all over, I addressed public rallies and I held three interview sessions.

Mrs. Opolot: That was your campaign strategy. Your opponent did not hold interview sessions, instead she mobilized other leaders and talked to as many individual students as she could. If the election results are anything to go by, then hers was a more effective strategy than yours.

Byaruhanga: I get the point now. Thank you Mrs. Opolot.

Teaching Techniques: The Building Blocks of Learning, Remembering, and Effective Teaching

If techniques of teaching are truly the building blocks of learning, remembering, and effective teaching, then there is good reason why you ought to know many different techniques. Suppose this moment you were asked to list ten different techniques you might use to teach a lesson. When you get beyond lecturing, discussion and reading the textbook, what other techniques do you think about? To meet the different needs of the students you are likely to be working with over the years, you might need no less than 100 different techniques to draw upon.

It is time to begin identifying building blocks of your instruction. Those blocks are represented by 150 techniques and activities that should stand as a reference; a reference that should be drawn upon when you need ideas. You are encouraged to examine each of the following techniques and activities, thinking about how you might use each one with students in a classroom.

1. ***Lecture*** by teacher (see chapter six)

One who hears forgets,
one who sees remembers
one who does learns.

2. ***Class discussion*** (see chapter six)

3. Recitation oral questions by teacher answered orally by students

4. Discussion groups conducted by selected student chairpersons (see chapter six)

5. Lecture-demonstration by teacher

6. Lecture-demonstration by another instructor(s) from a special field (guest speaker)

7. Presentation by a panel of instructors or students.

8. Presentation by student panels form the class: class invited to participate

9. Student oral reports by individuals

10. Student-group reports by committees from the class

11. ***Debates*** (informal) on current issues by students from class (see chapter six)

12. Class discussions conducted by a student or student committee

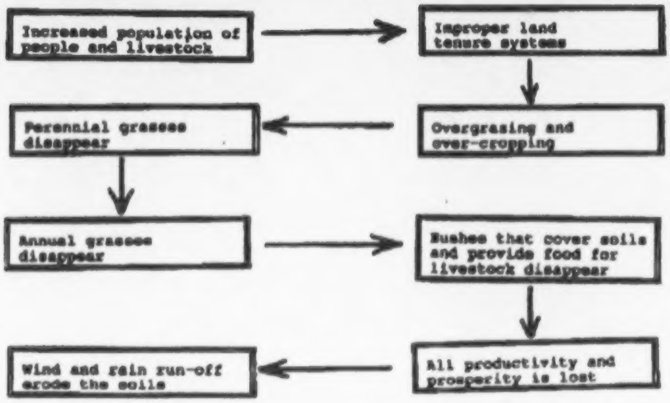
13. Forums (open discussion)

14. Bulletin boards

15. **Small groups** such as task-oriented (see chapter six)

16. **Choral speaking**
17. Collecting items: newspapers, magazines, pictures, bottle caps, etc.
18. Textbook assignments
19. Reading assignments in journals, monographs, etc
20. Reading assignments in supplementary books
21. Assignment to outline portions of the textbook
22. Assignment to outline certain supplementary readings
23. **Debates** (formal) (see chapter six)
24. Crossword puzzles
25. Cooking foods of places studies
26. Construction of vocabulary lists
27. Vocabulary drills
28. Diaries
29. Dances of places or periods studied.
30. Construction of summaries by students
31. Dressing dolls
32. Required term paper
33. Creating a class media center
34. Biographical reports given by students
35. Reports on published research studies and experiments by students
36. Library research on topics or problems
37. Written book reports by students
38. Making flags of ASESP countries
39. Jigsaw puzzle maps
40. Heroism by topic or era (military or political leaders, heroes)
41. Using flannel boards to tell a story illustrating a point
42. Using of pretest
43. **Gaming and simulation** (see chapter six)
44. Flash cards

45. Flowcharts


Increased population of people and livestock
Improper land tenure systems
Overgrazing and over-cropping
Perennial grasses disappear
Annual grasses disappear
Bushes that cover soils and provide food for livestock disappear
All productivity and prosperity is lost
Wind and rain run-off erode the soils

46. Interviews with resource people
47. Maps, transparencies, globes
48. Creating mobiles on specific topics
49. Audio-tutorial lessons (individualized instruction)
50. Making models, collages
51. Music to illustrate a culture
52. Field trips (local, national, international)
53. **Drama**, formal & informal (see chapter six)
54. Open textbook study
55. Committee projects—small groups
56. Keeping a notebook

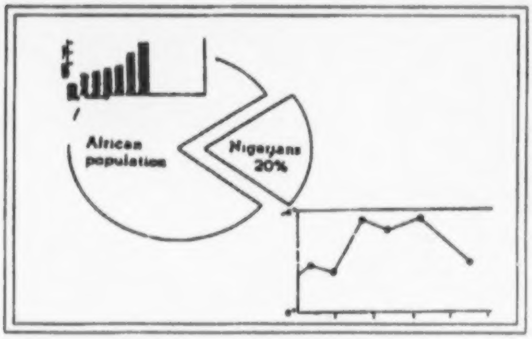
57. Murals
58. Class projects, community service
59. Individual projects
60. **Quizdown gaming** (see chapter six)
61. Modeling in various media
62. Pen pals from a different district, region, country

63. Taking and showing photographs

64. Performing experiments on the environment (testing soil, water, air)

65. Use of dramatization, skits, plays

66. Student construction of diagrams, charts, or graphs



67. Making of posters by student

68. Students drawing pictures or cartoons to vividly portray principles or facts

69. Case studies of people, places, or things

70. Puppets

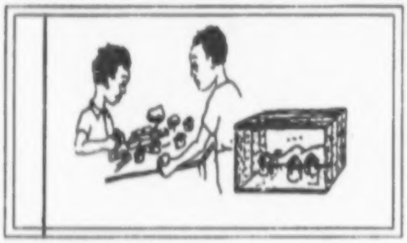
71. Use of chalkboard by instructor as aid in teaching

72. Use of diagrams, tables, graphs, and charts by instructor in teaching

73. Use of exhibits and displays by instructor

74. Reproductions of famous places, people, and events

75. Construction of exhibits and displays by students; e.g.diorama



76. Use of slides

77. Use of filmstrips

78. Use of motion pictures

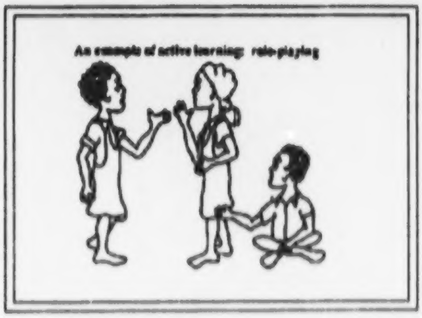
79. Use of theater motion pictures

80. Use of recordings

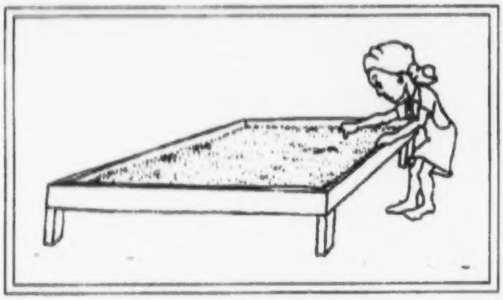
81. Use of radio programs

82. Use of television

83. **Role-playing** to illustrate an important point, to stimulate imagination (see chapter six)


An example of active learning: role-playing

84. Sand tables



85. School affiliations with other organizations such as sports, social, political, economic, community development

86. Verbal illustration: use of anecdotes and parables to illustrate

87. Service projects for the community

88. Using students' collections of stamps, coins, crafts, and other hobbies in class

89. Preparing a list of community or local, regional or district resources

90. Story telling by students, by elders

91. Surveying community needs and interests

92. Tutorial: students assigned to other students for assistance, peer teaching

93. Coaching: special assistance provided for students having difficulty in the course

94. Teaching good **oral report techniques** (see chapter six)

95. Using world association to improve learning and remembering

96. Using a workbook

97. Making classroom teaching aids such as paper, ink, colours, pens from indigenous (local) materials

98. Construction of scrapbooks

99. Applying simple statistical techniques to census reports on school, village, or district

100. Time lines

1980's
1990's
B
C
D
E

101. "Group dynamics" techniques, see chapter six on grouping

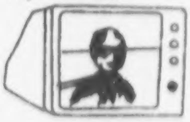
102. Units of instruction organized by topics

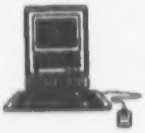
103. Small group tutorial

104 Supervised study during class period

105. Oral history: getting folk stories from elders

106. Use of advanced technology and instructional resources (see chapter six)


Television and Video Tape-recorder


Microcomputer

107. Open textbook tests, take home tests

108. Picture ideas

109. Writing a caption for chart, picture, cartoon

110. Reading aloud

111. Differentiated assignment and homework according to different learning styles

112. Telling about a trip or experience

113. Mock convention

114. Socratic small group

115. Preparing editorial for school paper or local paper

116. Attending council meeting

117. Exchanging "things" (stamps, coins, crafts)

118. Preparing and making announcements of coming events

119. Taking part (community elections, census survey, community development)

120. Playing music from other countries or times

121. Studying local history

122. Compiling list of elder citizens as resource people

123. Inviting students from different districts

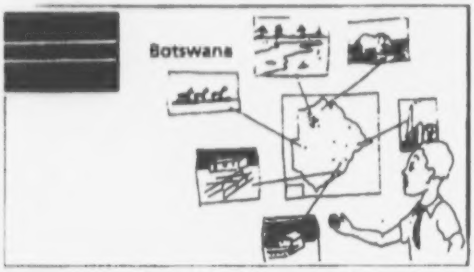
124. Obtaining free and low-cost materials such as local and national promotional materials, or tourist agency materials as classroom resources

125. Collecting old magazines

126. Collecting colored slides

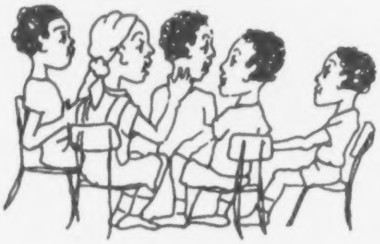
127. Visiting an "ethnic" restaurant (Traditional, Chinese, Indian, French)

128. Specializing in one country



129. Following a world leader (in the media)

130. Discussion small group



131. Starting a campaign (Save the animal!)

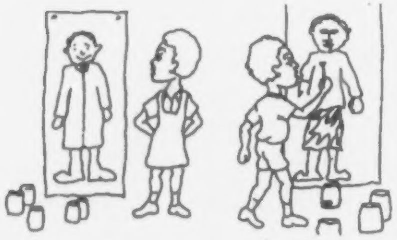
132. Conducting series of lectures, movies, plays

133. Investigating a life: national personality, family tree

134. Assisting an immigrant as a "big brother" or "big sister"

135. Volunteering for service to the school, to the community

136. Preparing an exhibit



137. Detecting propaganda in advertising and editorials in newspapers and magazines

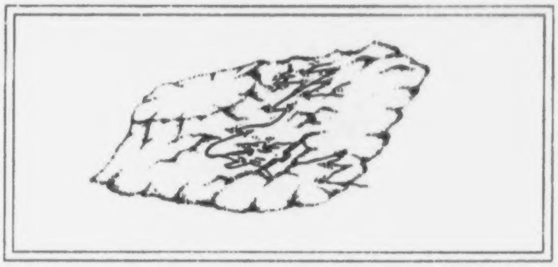
138. Joining an organization (sports, political, social)

139. Collecting money for a cause

140. Electing a hero for males: athletes, artists, musicians, statesmen, world figures

141. Electing a hero for females

142. Constructing a salt map

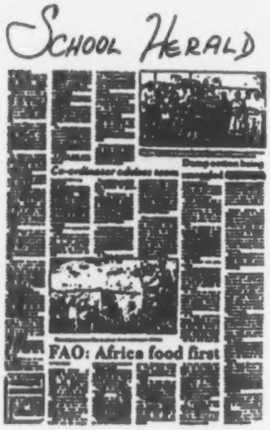


143. Constructing a drama

144. Preparing presentation for elder citizen group

145. Inviting elder citizen(s) to present local history to class including displaying artifacts (clothing, tools, objects, etc.)

146. Preparing mock newspaper on specific topic or era.



147. Drawing a giant map on floor or ceiling of classroom

148. Researching local historical (archaeological) site.

149. Exchanging programs with schools from different districts or countries.

150. Brainstorming: small group, students identify a list of techniques and strategies that best fit their class

The practice of teaching techniques requires student skill development to make them work.

Summary and Conclusion

This chapter has drawn a distinction between *methods*, *techniques*, and *strategies*; applied the research on learning, remembering, and effective teaching to methods, techniques, and strategies; and finally listed 150 techniques that were intended to stimulate interest and act as a reference. The point was made that there are only two methods, *transmission* and *problem-solving*. However, there are an infinite number of techniques that could be used in the classroom. A strategy is merely the plan by which the techniques are sequenced to accomplish the method. Educators are almost unanimous in their recommendation that teachers use active learning techniques with the hope, of course, that by encouraging students to participate, they will be increasingly motivated to learn and remember. But active learning does not just happen by accident. It must be planned. The rationale for studying about methods, techniques, and strategies is that these are basic to planning lessons. In the following chapter ten of the most basic techniques of teaching out of the 150 listed will be discussed and illustrated to demonstrate how they may be used when planning a lesson.

CHAPTER SIX

APPLYING METHODS, TECHNIQUES AND STRATEGIES TO TEACHING ENVIRONMENTAL EDUCATION

Introduction

In the last chapter we listed 150 techniques and activities from which a teacher can draw to organize her or his teaching effectively. We all know, however, that listing techniques is one thing and explaining their effective use is another. The purpose of this chapter therefore is to select ten of the most widely used techniques to illustrate how they can be applied in the classroom. The methods selected will include the following:

- **Lecturing**
- **Recitation**
- **Discussion techniques**
- **Audio-visual teaching aids**
- **Grouping**
- **Drama/role playing**
- **Oral report**
- **Debate**
- **Panel discussion**
- **Game/simulation**

Many educators will probably agree that lecturing, recitation and discussion are perhaps the most popularly used techniques. The basic reason for their popularity is probably that each of them usually does not require much skill development. They are thus considered to be easy to use.

Though lecturing, recitation, and discussion are not naturally passive, they are so often remembered and used by teachers that due to frequent repletion, they become passive to students. The same fate is likely to happen anyway to any technique that is overused.

Lecturing

Although it is one of the most commonly used technique, lecturing has been identified as one of the least effective as far as learning and remembering are concerned. This is not to suggest, however, that a lecture is not an important technique; in fact it is one of the most important ones. In your teaching you will often have to use it, for example, to introduce, summarize, explain, share and provide information. If well used, this kind of lecturing is quite useful because it focuses attention.

The problem with lecturing is holding student's attention. Research on attention span at different grade levels suggests that lecturing for a full class period is difficult because students have a finite attention span, and as the limits of that attention span are reached, students begin to tune in and out more rapidly. Do you remember that the chapter on research said, *"we learn and remember 10% of what we hear"?* We believe that a well-planned and skillfully presented lecture can be an exciting learning experience. Lecturing should fit effective teaching practices by focusing students' attention. The following are guidelines for the effective use of lecturing.

A Few Suggestions

♦ Use lecture to:

- introduce a lesson
- focus attention
- summarize a discussion or lesson
- explain an activity

When you plan a lecture, ensure an introduction that will "grab" students' attention. In other words, the introduction should create "high interest" and act very much like a springboard-launching for the class into the lesson. When ending a lecture, a brief summarization will focus attention on the main points of the lesson. The teacher's responsibility is to clarify and summarize the points of the lecture so that students can identify patterns, that is, learn and remember. Closure (ending a lecture) is the point at which the class should start the next day. For example, "Do you recall the ideas we talked about yesterday? Would you find in your notes, the summary of those ideas? Do you remember that we talked about soil erosion in Lesotho and that today we would discuss soil erosion in Sierra Leone Would you now turn to your atlas and find the map of West Africa? Locate Sierra Leone on the map."

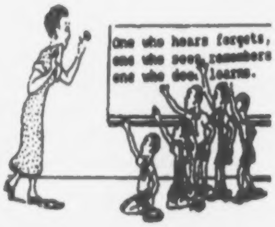
- **A lecture is an efficient way to give information, but not information students can get from their textbooks**, reading materials, or student handouts. Use a lecture to impart new information. As already noted, the chapter on research indicated that students will learn and remember more of what they see than what they hear. Visual aids and discussion will measurably improve students' remembrance of points made in the lecture.

- **Keep lecturing to a minimum** and combine it with other active teaching techniques in a single class period. Two or three different teaching techniques in a class period will prolong students' attention and increase quality time on task. Several short lectures combined with other teaching techniques is an effective use of lecture.

- Based on the average attention span of students, **lectures should last only 5-10 minutes for primary school** *students*, 15 minutes for junior secondary students, and no more than 20 minutes for secondary or high school students. The longer you talk, the less students will listen.

- **Lecture from notes; do not read a prepared script**. An outline of the main points of your lecture written on the board, overhead projector, or in a handout will help students focus as you lecture. A lecture interspersed with higher level, thought-provoking questions will also encourage students to focus attention and increase learning and remembering.

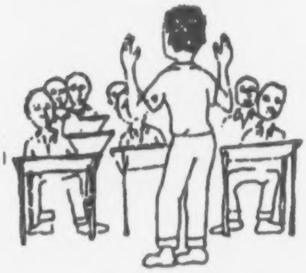
Recitation

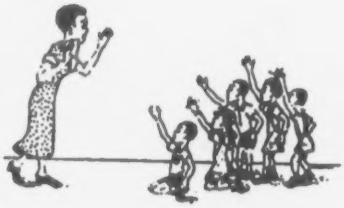


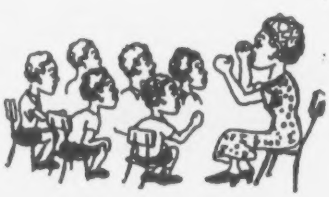
Recitation and discussion both engage the class but for different purposes. Can you distinguish recitation from discussion? There is a difference. Recitation is the oral delivery of memorized materials normally addressed to the teacher, a cognitive memory or convergent level response. On the other hand, discussion is a purposeful consideration of a topic by class members addressed to other class members and the teacher, and is usually at a convergent, divergent, or evaluative level. Do you identify the difference between recitation and discussion? For example, a recitation is when the teacher asks the class, "State the three main causes of desertification in Africa". The only way to answer that question is to have read the text and memorized the three causes. Reciting the causes is called recitation.

Example of a Recitation Activity

Method: transmission
Strategy or sequenced techniques:
(1) introductory lecture,
(2) recitation, and then
(3) discussion.







PROVERBS AND WISDOM

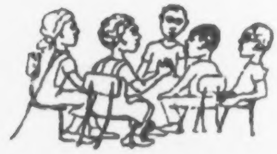
Purpose: practice recalling customs of a village
Objective: gaining knowledge
Effective Teaching Practices:
  - **self-esteem, integrating, accommodating**
  - **Recalling and reciting proverbs encourages up to 40% learning & remembering**

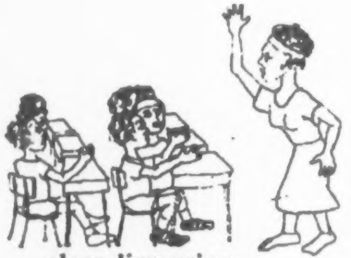
Duration: one class period
Teaching/learning aids: Chalkboard
Strategy: Teacher explains that this is a lesson on proverbs and social custom. The teacher might continue by saying, There is much wisdom in the village and that wisdom is often found in the form of proverbs taught to us as children. Recall some of the proverbs you students have heard and memorized. For example, in my village it is often said, 'Knowledge is like a garden; if it is not cultivated it cannot be harvested' or 'He who is unable to dance says that the yard is stony'. As the students recite proverbs the teacher writes them on the chalkboard for the purpose of discussion. Examples of proverbs:

a. A close friend can become a close enemy
b. One who recovers from a sickness forgets about God
c. Unless you call out, who will open the door?
d. When spider webs unite, they can tie up a lion
e. You cannot build a house from last year's summer
f. A blade won't cut another blade; a cheat won't cheat another cheat
g. Where there is no shame, there is no honor

Discussion

Discussion which calls for a purposeful consideration of a topic might commence with a question such as "How do you account for the fact that Environmental Education in Africa is not as developed as it is in many Western countries?" This question calls for knowledge about Environmental Education in Africa; it also calls for speculation or personal opinion on the level of development of EE in Europe and elsewhere. The chapter on research stated that, "we learn and remember 40% of what we discuss with others". Of course, that is 40% if the members of the class participate. If only two students are actively discussing with the teacher and the other members of the class are passive and indifferent, then only two students may be getting the full benefit from the discussion.


small-group discussion


class discussion

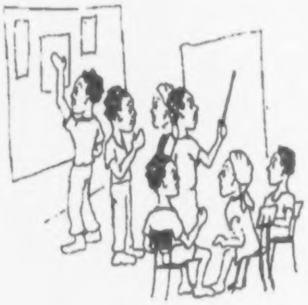
The following are guidelines for developing effective discussion techniques.

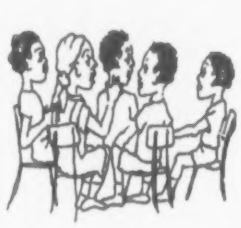
You should:

1. **Clearly identify the purposes/objectives for the discussion; in short, make sure there is a point to the discussion and the students know what the teacher wants, e.g., "The subject we are going to discuss is on the environment".**
2. **Suggest and guide the development of a topic to be discussed, e.g. "First identify the conditions that led to the environmental problems we face as a country".**
3. **Assist students in maximum participation in the discussion. Ensure that you include all students in the class by skillful use of different levels of questions.**
4. **Accept student contributions as worthwhile no matter how limited the value may be. In fact, encourage students' questions for this is one of the best techniques to encourage focused prolonged attention. Students asking good questions is the sign of a successful discussion.**
5. **Suggest appropriate time schedules, how long the discussion will continue, e.g. "We will discuss the conditions leading to the environmental problems in our country for five more minutes".**
6. **Provide the summary remarks or conclusions based on what students have discussed. This summary can also be given by a student. If the teacher wishes to check the class' understanding of the topic, it is often a good practice to ask students to summarize.**
7. **Evaluate the discussion activity—what went well and what needs to be improved, e.g., how many students participated? Do you believe you are getting the 40% learning and remembering that discussion is intended to achieve, or does the participation suggest more like 10%? Do your discussions often become lectures? Was it actually your intention to lecture rather than have a discussion?**

Example of a Discussion Activity:

Method: problem solving
Strategy or sequenced techniques:
(1) use of teaching aids and
(2) discussion





THERE'S NO PLACE LIKE HOME, BUT...

Purpose: **Practicing map skills and decision making.**
Objective: **Examining values and beliefs**
***Effective Teaching Practices*: Accommodating, challenging. Discussion encourages approximately 40% learning & remembering.**

Duration: One class period
Teaching/learning aids:
Large map of Africa divided into four regions: Northern Africa, Southern Africa, Western Africa an Eastern Africa.

Strategy: Each class member must pick a region, and in that region a country, and in that country a city/town where he/she would like to live. The following must be taken into consideration: climate, location's opportunities or attractions, city/town size (an atlas often gives population next to a city's name in the index). Have students indicate their choices on the map by pinning their names to the locations.

How many chose where they currently live?
What was the farthest location chosen?
What was most important in making the choice: climate, attractions, size etc?

Grouping

Grouping students for the purpose of instruction has become popular with many teachers. Officially, grouping is defined as assembling students in groups for the purpose of instruction. Grouping has become popular because this technique emphasizes active student participation. Participation in small group discussion may help students learn and remember up to 40% according to research. Keep in mind that 40% learning and remembering may happen if students are actively participating in the small group discussions. However, if in groups of five students, only two do the task assigned to the group, three remain passive, then those three are not spending quality time on the task. Thus, the technique is not working for those three students. It is difficult for a teacher with a large class to provide an opportunity for every student to participate during each class period. Grouping offers one technique by which students in groups participate among themselves and in so doing become actively involved in class work. Students reluctant to participate in class recitation or discussion can be encouraged to be involved in small group discussions. Some teachers dislike grouping because they feel that many students are willing to waste time by not focusing attention on the assigned task. It is true that grouping will not work well unless the task assigned is understood and the students are co-operative.

Five Types of Grouping

The most recent development in grouping has been the identification of at least five different types of grouping for instructional purposes. The five types are listed here.

1. **The task oriented small group** for the purpose of focusing on a specific project or proposal.

2. **The brainstorming small group** for the purpose of discussing freely and uninhibitedly a topic which is problem centered or solution centered.

3. **The tutorial small group** for the purpose of emphasizing individual instruction, usually of a remedial nature, or to evaluate an independent study project.

4. **The discussion small group** for the purpose of encouraging free and uninhibited discussion by students of a topic which has some previous structure and relevance to material under consideration and

5. **The Socratic small group** for the purpose of bringing students and teacher(s) together to discuss a problem posed by the teacher for which an answer can best be determined through

the open and honest exchange of informed opinion.

Successful Grouping

Grouping often fails when students do not know what to do in their groups, which means the group is not focusing on the task at hand. How should teachers focus the students' attention to achieve a good purpose? The following suggestions may help.

Keys to Successful Grouping

1. **How to assign students to groups? Four suggestions:**
    - **a) Arbitrarily assign.**
    - **b) Do it by interest groups, e.g., 'those studying the vegetation zones of West Africa meet over here'.**
    - **c) When students enter the classroom, hand each student a piece of coloured paper. Groups are determined by the colour of the paper, eg., "All greens meet by the window".**
    - **d) Have students count off by number of groups desired, "All ones are in the back corner of the room".**
2. **Does the group need a leader? Either appoint a leader or have each group select a leader if needed.**
3. **Will there be a report from the group? Who will take notes? Either the teacher or the group will make these decisions.**
4. **Set a time limit if that is appropriate. You or the class should determine how long it will take to accomplish the purpose of the grouping. Groups will fill whatever time you give them. Suppose the task could be done in ten minutes— if you give them no limit, they might take the whole class period and still not finish. The class that takes an hour to do what could be done in ten minutes is not practicing quality time on task, and this could lead to discipline problems.**
5. **Evaluation: A common complaint in a group is that a few students do most of the work and the other group members are passive and unfocused. Also, not all students work well or enjoy grouping. There is a need for evaluating what is happening and what students think about grouping. Make sure the class knows that you will be asking for an evaluation that identifies those who did not contribute and for students's attitudes about grouping. Study the "Evaluation of Self and Group" at the end of this section.**

Activities/Strategies that Illustrate Grouping Techniques and Evaluation

To know the names of the five different types of small group organization and keys to successful grouping is not necessarily to know how to use these small groups in classroom activities. Try to apply these five key ideas about grouping to the following activity that illustrates a task-oriented small group technique to develop the processing skill of classifying and categorizing.

Method: problem solving
Strategy or sequenced techniques:
(1) grouping
(2) teaching aids, and
(3) discussion

WHAT WE NEED

Purpose:Practice skills of classifying and categorizing
Objective:Using and refining information
Effective Teaching Practices: Accommodating, self-direction, integrating. Discussion encourages approximately 40% learning and remembering.

Duration: Three class periods
Teaching/learning aids: Magazines, newspapers, brochures, etc.

Strategy: Divide the class into task-oriented small groups of four or five students each. Have each group cut out pictures of things students think are necessary in order to live. Groups should place similar things (e.g.. clothing) in paper folders (first class period). Have one folder labeled "Group Problems" for pictures that do not easily fit into a category such as shelter, heat, health, food.

Have a class discussion. Each group shows its folders to the entire class. Do other groups have folders of similar categories? Put similar pictures from all the groups together and label each category, e.g., clothing, food, tools, etc. Then have each group look at its problem pictures, such as television set, car, electrical appliances, etc. (second class period). Groups should discuss each problem picture to see if it fits a category, needs a new category, or if the item is not necessary (third class period). Teacher should help groups as they work.

Below is an "Evaluation of Self and Group" form. Students can evaluate their own participation with the group and the group's participation as a whole. If the technique of grouping is used often in class, then a form such as this should be periodically administered.

EVALUATION OF SELF AND GROUP

Instructions:

Check the response that best fits your feeling about yourself and the group you have been working with.

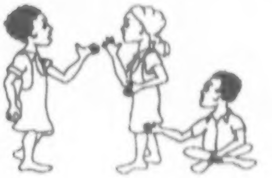
Date:
Name:

A- almost all of the time
B- frequently
C- average
D- below average
E- did not do

SELF	A	B	C	D	E
1. I participated by making suggestions, arguing and discussing.					
2. I co-operated by listening to others and tried to work out difficulties (compromises).					
3. I am satisfied that I did my best to accomplish the group task.					

GROUP	A	B	C	D	E
4. The group made a real effort to accomplish the group task.					
5. The group worked well together by co-operating with each other.					
6. The group shared the responsibilities: no one was left out.					

Drama/Role-Playing



The technique of drama involves the students in an enactment (role-playing) of some event or feeling. This technique encourages students to learn through dramatization, by expressing in their own words the drama of the event. Some authorities will classify drama under the heading of role-playing and, of course, most of what happens in drama is role-playing. Thus students experience directly or practice. This encourages 80% learning and remembering. Many teachers have begun to take role-playing seriously because this technique does force students to be actively involved in historical, political, or social events. The dramatization provides an active situation in which the student not only participates, but also must interpret, thus, developing feelings, attitudes, and reinforcing knowledge, an exceptionally good technique to focus quality time on task. Normally drama is used in one of two ways in the classroom: extemporaneous (impromptu) drama or formal (skits, scripted) drama.

Many teachers use an extemporaneous form of drama. Extemporaneous, meaning without preparation, emphasizes the students responding to a situation or a set of feelings without prior practice. The teacher might ask students to dramatize an historical situation; for example role-playing the immediate response of the pastoralist Maasai to the introduction of modern agriculture in their part of Kenya, or a village meeting such as a Botswana Kotla where specific problems may be discussed. Teachers also use formal written drama or scripted plays to emphasize certain historical or contemporary events. The plays and skits are often written by students and acted for the class.

The following illustrates a drama/role-playing technique where students learn to identify differences between fact and opinion by role-playing stereotypes. (A stereotype is a commonly held opinion or mental picture we have about something or some people that may or may not be true).

Method: *Problem solving*
Strategy or sequenced techniques:
(1) teaching aids,
(2) role-playing, and
(3) discussion.

I AM PRETENDING TO BE A STEREOTYPE

***Purpose*: Identifying differences between fact and opinion**
***Objective*: Using and refining information**
Effective Teaching Practices: Reinforcing, challenging, feedback.
Discussion encourage approximately 40% learning and remembering.

Duration: One class period
Teaching/Learning Aids: Small cards with the name of an occupation or person that is often stereotyped, for example, doctor, village chief, teacher, grandmother, store keeper, farmer, bus driver,

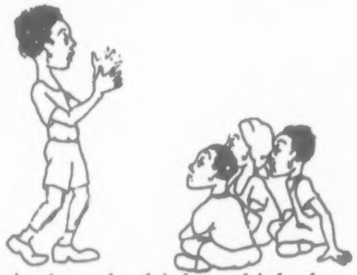
Strategy: Have each student draw a card with name of occupation or person and role-play that occupation. Can the class guess who or what occupation is being role-played? Discuss characteristics commonly used to stereotype each specific occupation or person.

For example:

(a) Are the characteristics true to life?
(b) What are other characteristics common to this occupation or person?
(c) Suppose you worked at this occupation, would you try to practice a different set of characteristics?
(d) Are stereotypes of occupations helpful or harmful when trying to understand the world of work?

Oral Report

One of the favourite techniques among experienced teachers is the oral report. Normally this technique requires a student to report to the class on a particular topic. Teachers have traditionally favoured this technique because it has placed emphasis upon research and oral presentation, both of which are thought to be important citizenship skills. Oral reports can be informal, such as when the students are asked to report on some personal incident of which they have knowledge, or formal as when the student is required to research a topic.



The fact that oral reporting is a favourite technique also suggests that as a technique, it is often abused. The obvious intention of the teacher is to encourage the student to have something to say (through research, personal experience, or reporting results) and thus practice the skill of communicating this to the class. The oral report tends to be inappropriate when there are no criteria for a good presentation. The practice has been for teachers to concentrate on research techniques and other means of gathering information, but they have not offered equal standards for oral presentations. Keep in mind that oral reporting as a technique can be very effective if there are criteria (standards) by which the student and teacher can judge the quality of the presentation. Students cannot improve their oral presentations if teachers cannot identify the difference between a good and bad oral report. As minimum, set limits such as time limits, i.e. 2 minutes, 5 minutes; encourage preparation; and develop criteria by which the reports will be evaluated.

Following below find an oral report checklist which students may use as a guide to prepare oral reports and teachers may use to evaluate the presentations. The checklist does offer the criteria by which students and teachers can judge the quality of the presentation.

ORAL REPORT CHECKLIST

____ Student's name

	Well done	Satisfactory	Needs attention
1. Approved outline			
2. Write subject on chalkboard			
3. Face class, speak slowly			
4. Identify source			
5. State time and place of subject			
6. Relate subject to what class is studying			
7. Give report from notes (no reading)			
8. Write difficult names and words on chalkboard			
9. Summarize			
10. Be ready for class questions			
11. Comments			

Using the Oral Report Checklist, have students prepare oral reports such as in the following activity.

Method: Transmission.
Strategy or sequenced techniques:
(1) research,
(2) Oral reports, and
(3) teaching aids.

ORAL REPORT

Purpose: **Identify historically important persons, places or events in the area of environment and development**
Objectives: **Gain knowledge**
Effective Teaching Practices: **Challenging, self-esteem, reinforcing.**
Making an oral report by the class encourages approximately 80% learning and remembering, and listening to and watching the reports encourages 20%.

Duration: presentation of reports as appropriate to the development of the lesson.
Teaching/learning aids: List of environmentally important persons, places, or events for students to report on

Strategy:

(1) Assign or let students select a topic to report on from the prepared list. Allow adequate time for students to research topics.

(2) Have students find or draw a picture or prepare a poster about the event or person or place they have researched.

(3) Have students dress up as the person they researched if they wish to.

(4) Have students locate on a map where the person they research lived or where the event they researched took place. A little flag of the event or person's name might be pinned to a map where the event took place.

(5) Students should report orally to class, displaying their pictures and explaining who their person, event, or place is and why they are important.

Debate

Debate encourages deliberation, argument, and discussion of opposing points of view. This technique allows students to apply the knowledge they have acquired. It is also used to help students develop the skill of preparing arguments for one or another side of an issue. Debate is used in either a formal or informal way. Some teachers like to require their students to learn formal rules of debate. The intent is to teach students the procedures for developing formal argumentation. Most teachers, however, use debate in an informal way—that is with modified rules of debate that are appropriate to the class. The informal technique is intended to prepare students to defend a particular point of view, i.e., argument, stand, or position. The informal technique permits the teacher and students to develop their own set of rules. It is intended that the students be actively involved in preparing and defending an argument. Teachers often use this technique to illustrate that there are many different points of view that can be debated. In short, debate focuses attention and can generate quality time on task for the purpose of examining problems and issues.

A few suggestions

The following activity illustrates one use of the debate technique.

Method: Problem solving
Strategy or sequenced techniques:
(1) discussion,
(2) grouping,
(3) debate, and
(4) discussion and voting.

DO WE NEED RULES?

***Purpose*: To examine problems and issues**
***Objective*: Using and refining knowledge**
***Effective Teaching Practices*: Challenging, reinforcing, rewarding. Participating in debate encourages approximately 80% learning and remembering.**

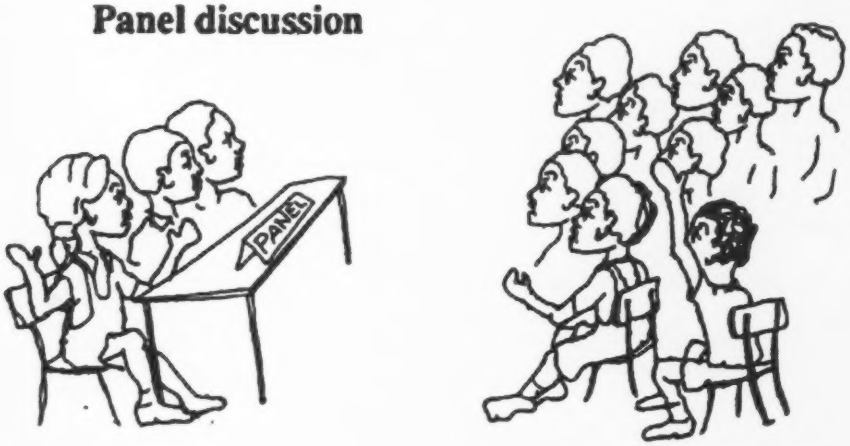
Duration: As needed to complete activity
Teaching/learning aids: List of rules suggested by class debate and task-oriented small groups.
Strategy: Have students think of rules that control their lives, for example, family rules, school has rules, community has rules, country has rules, driving has rules, sports/games have rules. List on the board the rules students suggest control their lives. Divide the class into small debate teams of four or five members. Assign one team to defend several of the rules and assign another team to argue that those same rules are unnecessary. Continue assigning teams selected rules to defend or challenge (argue that the rules are unnecessary) until all teams have a position to defend. Give teams time to prepare. Have one set of teams (one team defending and one team challenging a specific set of rules) debate their set of rules in front of the whole class.For example, each team has five minutes to argue for or against a rule. Continue allowing sets of teams to debate until all teams have had a turn each. As a conclusion to the activity, ask the class to express their opinion by voting for or against each rule listed on the board.

Panel Discussion

Teachers use panel discussions to present information to the class. The panel often consists of a number of students who are assigned to act as a team to research and present a particular topic. Normally the panel orally reports their findings on the topic to the class. Some teachers also require that the report be written as well as orally reported. The panel differs from debate in that it is not intended as a means of stimulating debate among the panel members, but rather, as a systematic way for a team of students to present together their report on a topic. The following is an activity using the panel discussion technique.

Method: Problem solving
Strategy or sequenced techniques:
(1) research,
(2) grouping, and
(3) panel

Panel discussion



RESEARCHING THE AFRICAN CONTINENT

***Purpose*: Investigate several selected countries in different parts of Africa**
***Objective*: Gaining knowledge**
***Effective Teaching Practices:* Self-direction, integrating goal, self-esteem, challenging. Participating in a panel discussion encourages approximately 80% learning and remembering.**

Duration: Two weeks
Teaching/learning aids: Resource materials, list of African countries, panel small group
Strategy:

(1) Divide class into task-oriented small groups (each group will act as a panel). Give each group a portion of the names from the list.

(2) Each group will research its own list of countries using the following questions:

(a) Where on the map is the country found?
(b) Why is the country important to study?
(c) Suppose you could visit this country, what would you want to see?
(d) How would you feel about living in the country?

(3) Each group may be requested to turn in a written report on its findings.

(4) Each group will act as a panel to report to the class in an oral presentation. Each panel member will deliver some part of the panel report so that all panel members have a chance to participate.

Game/Simulation

You know what a game is, essentially a competition with a set of rules where people play to win in a contest. But what is a simulation, a pretending, an imitation? Simulation is also a game, but there are no necessarily winners or losers; depending on the purpose of the simulation. Role-playing is often a part of simulation. For example, students in a simulation would role-play the process by which laws are made in a country. Whereas a game in class could be students teamed up for a competition such as spelling or locating countries on a map. The team that spells the most country names correctly wins the game. The difference between gaming and simulation is that in gaming there is always a winner, but in some simulations there may be winners or losers, it depends on the purpose of the simulation. In short, most of the time, simulation is role-playing an imaginary event using a set of rules. Illustrations of gaming and simulation will help to demonstrate the similarities and differences.

Benefits of Gaming and Simulation

Gaming and simulation are included as techniques because they can be of value by enriching the effectiveness of a teacher's instruction. Simulation also fulfills most of the practices suggested to achieve effective teaching such as self-directing, accommodating, integrating, challenging, feedback, and rewarding. In short, a simulation, when properly presented, is the most powerful technique for generating creative thinking and effective learning. Gaming and simulation are motivational techniques because students enjoy games, meaning they generally have a positive attitude toward participating. Some of the advantages of using games and simulations are to:

1. review content as in a quizdown
2. encourage critical and creative thinking
3. offer an opportunity to teach role-playing
4. teach content as well as process
5. add variety and a change of pace to your teaching.

A few suggestions

Illustration of a game activity

Method: Transmission
Strategy or sequenced techniques:
(1) teaching aids and
(2) quizdown game.

QUIZDOWN NAME GAME

***Purpose*: Practicing map skills, locating, naming, and spelling different countries.**
***Objective*: Gaining knowledge**
***Effective Teaching Practices*: Reinforcing, challenging, rewarding. Participating in a game encourages approximately 80% learning and remembering.**

Duration: One class period per game
Teaching/learning aids: Maps or globes.
Strategy:

1. **The first student names a continent such as "Africa". In this case the continent's name ends with the letter "A". The second student must name a country in Africa that also ends with the letter A, such as Nigeria. The third student then names a country that also ends with the letter A, such as Kenya. Students continue naming countries until no more countries ending with A can be found in Africa. Last student to name a country with the letter A wins the game. That student then selects the name of a different continent and the game continues. Could also be played by teams.**

A variation of this name game - 20 questions:

2. **Have one student leave the room. Class picks names of country, city, or landform, etc. in Africa. Student returns and tries to guess the place by asking twenty questions that can only be answered by yes or no. For example, Is it small? Is it water?, If not successful in guessing, then another student has a turn. Could also be played by teams.**

Illustration of a simulation activity.

Method: problem solving
Strategy or sequenced techniques:
(1) task-oriented grouping,
(2) simulation, and
(3) discussion.

WHO WILL GO?

Purpose: Practice rule-making and decision making
Objective: Examining values and beliefs
Effective Teaching Practices: Challenging, self-direction. Participating in a simulation encourages approximately 80% learning and remembering.

Duration: One period
Teaching/learning aids: List of individuals requesting to go to domed city on the moon.
Strategy: This is a contemporary problem in selection for settlement. This activity involves selecting appropriate people for a settlement, and anticipating problems that might arise in the habitat.

> A domed city with controlled climate and life systems has been built on the moon to house a community of settlers. A national selection committee has been established to determine what people may be transported to the domed city.

1. Divide the class into groups of four to six students per group.

2. Each group should imagine or pretend that it represents the national committee with the responsibility of choosing seven people from the list to go to the domed city.

3. The list of seven the group chooses must be approved by a majority of the members of the group.

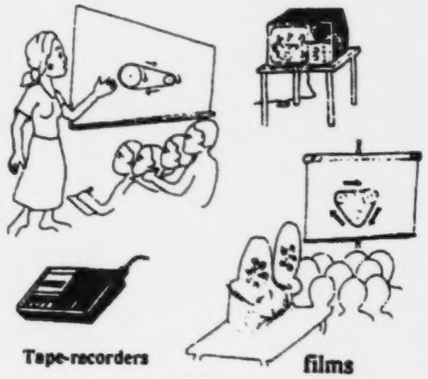
4. After the small group has completed their lists, the entire class should compare and discuss the different groups' lists. Keep in mind that the very life (survival) of the new settlement may well rest on the right choice of people. There is no "correct" list of the seven people who can go.

INDIVIDUALS REQUESTING TO GO TO DOMED CITY

1. 35-year-old carpenter who is going blind.
2. 20-year-old alien from neighboring country who is a computer expert.
3. 68-year-old retiring army officer.
4. 33-year-old doctor suspected of selling illegal drugs.
5. 25-year-old female electrician with a history of emotional problems.
6. 37-year-old primary school teacher with a retarded son who will only go if he can accompany him.
7. 48-year-old farmer and wife who is a special education teacher who will only go together.
8. 40-year-old musician who is going deaf.
9. 35-year-old politician.
10. 23-year-old art teacher.

Audio-Visual Teaching Aids

We have said up to this point that as alternatives to lecturing, recitation, and discussion techniques, you ought to think of grouping, drama/role-playing, or report, debate, panel discussion, and game/simulation. These techniques, if properly applied, should focus attention and help to motivate by encouraging student participation. According to research, active learning through participation should help students learn and remember. One additional way to be effective is through the use of audio-visual teaching aids. The activities that illustrate the various techniques of teaching in this chapter also show that audio-visual teaching aids are an important part of the strategy.



The use of audio-visual teaching aids is particularly important because Environmental Education is not only a new field of study but it seems to be all embracing. As such, in order to facilitate effective teaching and learning in this field it is important to visually demonstrate concepts, and it is important to provide models. We need not belabour this argument for few teachers would argue that illustration is not a significant part of teaching, and those illustrations which most reliably transmit a clear picture are the most effective audio-vidual teaching aids.

The following is an illustration of the use of audio-visual teaching aids.

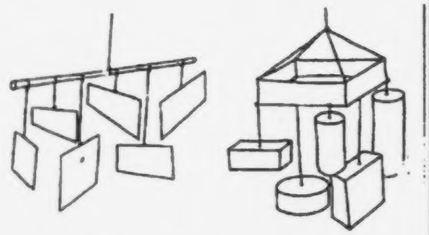
Method: transmission
Strategy or sequenced techniques:
(1) grouping,
(2) research, and
(3) teaching aids.

INVESTIGATING A SOCIETY

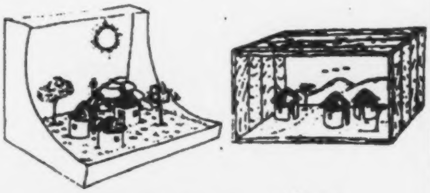
Purpose: Identify the effects of environment on societies and cultures
Objective: Gaining knowledge
Effective Teaching Practices: Goal setting, self-direction, accommodating. Creating a visual presentation encourages approximately 80% learning and remembering.

Duration: Two weeks
Teaching/learning aids: Materials as needed
Strategy: Divide the class into task-oriented groups. Each group must choose a society or culture to study. Students research to learn about the land, people, customs, government, food, housing, religion, arts, etc. Each group decides how to present its information as a visual aid to the rest of the class. For example:

1. Mobile: Each shape hanging from a mobile must represent something in the society being reported on. Each member of the group will have several things hanging on the mobile to explain and perhaps elaborate on to the class.



2. Diorama: Group will need to construct a diorama to represent the society being reported on. Different parts of the diorama can be constructed by individual members of a group, making sure however that the diorama is a complete visual aid when finished.



3. Drama: Group prepares a role-playing/drama that includes costumes, scenery, props, singing, dancing, food, etc., that is representative of the culture of society being studied.

Sample Lesson Plan

Time: 80 minutes *Date*:

Subject: Social Studies/Agriculture

Topic: Deforestation and its effects

Concepts: Deforestation, environment, resource

Learning Resources:

Reference books on trees in the country

- The environment
- Posters
- Video programmes
- Library
- Display boards

Objectives - Students should be able to:

1. Define the concept *'deforestation'*
2. Identify human activities that lead to deforestation
3. Record and report information accurately.

Introductory Activities

You or one of the students (narrator) should introduce the play and in the process introduce the farmer, his family, the forest ranger, other forest users, who are all in place, ready for the dramatization.

Scene 1

There is no fuelwood in the home. The farmer goes to the forest to fell trees. Each tree species protests and objects to being felled, spelling out the importance of the species. The farmer gives reasons for felling the trees.

Scene 2

Scene 1 is repeated as the other forest users i.e. the charcoal burner, timber dealer, the traditional healer come to fell trees, from the forest.

Before all the species have been felled, the forest ranger comes, intervenes and educates the forest users, on the importance of trees and their wise use. She is ignored, and wanton deforestation continues.

Scene 3

All the forests have been felled and there is famine in the land. The soil has been eroded, the weather has changed.

All the characters complain. The family complains to the farmer; the timber dealer can earn no money; the charcoal burner has no business; the traditional healer has no drugs to dispense. Scene ends.

Development Activities

1. Have students identify the problem that each of the users has caused as a result of felling trees.
2. Have students make assumptions of what the environment might have been like in the past and why it has changed.
3. Students conduct a library research on forests and their uses.
4. Conduct a general class discussions and have students report their findings. Summarize these in tabular form as below.

Human Activities	Effects on forest	Results
1. Clearing of forest for farming		
2. Lumbering		
3. Cutting trees for firewood		

5. Students in small groups should adopt the role of Ministry of Agriculture and Forestry. Have them design a policy that the people would follow in using the forest wisely and in solving the problems that arise from misuse of forests.
6. Have students display their policy guidelines for comparative discussion and summary by the entire class.

Concluding Activities

1. Ask students to tell what they have learned in the lesson about the uses and abuses of forests and the problems that arise therefrom.
2. Students should say what they would do to solve the problems of deforestation in their own neighborhood.
3. Effecting these suggested solutions should involve students planting and caring for trees in the school compound or at home.

Self-evaluation

Using the following guidelines, evaluate yourself and the lesson you have just taught. It would be very useful if you could involve your students in the evaluation.

1. Name the teaching techniques that you have used and describe the lesson's strategy.
2. What method has the lesson used and why do you think so?
3. How effective was each of the teaching techniques you used? Consider indications such as students' attention, participation and how much evidence of learning they showed during the various activities of the lesson.
4. What skills were the students able to develop during the lesson?

Activity

This activity is intended to demonstrate to you how inquiry and problem solving can be initiated and conducted in a lesson. It uses the group discussion technique which is called the "goldfish bowl" discussion.

Resources

Besides the usual stationery required for any class, you need to identify a newspaper or magazine article on a controversial topic. A good example is one of squatters in forest reserves and national parks. Considering their needs, shortage of land and the threat that wildlife and forests face, should be squatters be removed from the reserved areas or not?

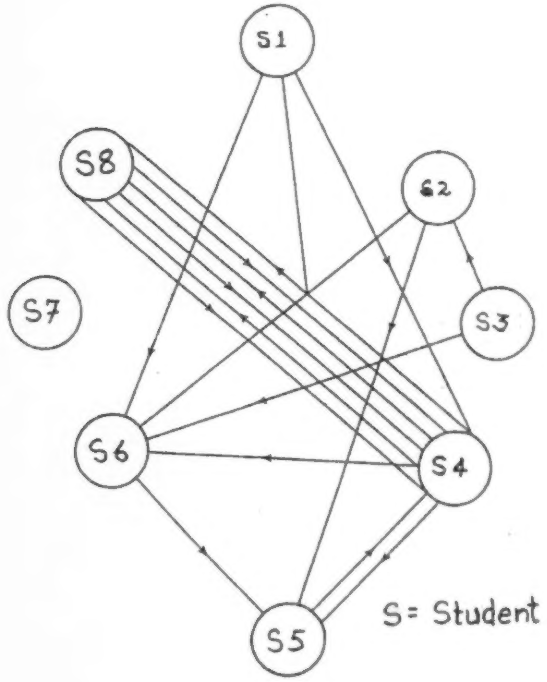
Procedure

1. Read the article and decide:
    (a) the issues and problems that can be discussed or investigated in the clasroom on the basis of the article

    (b) as many questions as possible that can be raised in relation to these issues/problems.

2. Let the class read the article (photocopies, retyped or displayed on the noticeboard before the lesson).

3. Divide the class into groups of 8 to 12 students. Seat them as in the discussion map below. Appoint two observers for each group.



Rules

1. Everyone is entitled to their opinion
2. Conclusions are welcome but not necessary
3. Only inner circle group members are allowed to talk; outer circle members are observers and are strictly forbidden from intervening in the discussion
4. One of the observers builds a discussion map to show the origins an destinations of statements/ideas.

Debriefing

A good guide to an effective debriefing has been provided by Pike and Selby (1988:129). After discussion obervers are asked to explain how they perceived the dynamics of the discussion. Their comments should not be so much directed at the respective quality of arguments and ideas advanced but at the performance of the inner group as participants in the discussion process; e.g. the body language employed, the degree to which people were really listening to each other, the extent to which each other's contribution, or were simply intent on injecting their own ideas, examples of prejudice, obstructive or overbearing behaviours, etc. The process is then repeated with the discussion and observation groups exchanging places and roles.

Every time a student makes a contribution, however small, to the discussion, the observer records the fact on the discussion map by drawing a line. If a contribution is directed to a particular person, a line is drawn to that person. If it is directed to the group, a line is drawn to the centre of the circle. If a contribution is interrupted or not completed for whatever reason a short line is drawn. Arrows can be used to indicate the flow of discussion between individuals. A record of contributions made is thus built up.

The observer joins the circle and shows the group the disucssion map (it is also important that a facilitator joins the group to conduct the debriefing). In the case of the discussion group illustrated, Jenny might be the first to be asked to comment on what the map shows so as to avoid her further exclusion. It can be suggested to her that she is probably in the best position to comment on the discussion in that she chose to observe rather than to contribute. Rachel, Peter and John might also be invited to contribute their impressions before the discussion is thrown open.

CHAPTER SEVEN

TEACHING AND LEARNING RESOURCES

Introduction

Teaching and learning resources are all those materials which a teacher can use to facilitate and enhance teaching and learning. Just to remind you, **we learn and remember 90% of what we attempt to teach others**. In order to achieve this level of success teachers have to do a considerable amount of preparatory work, consulting a variety of resources. Learners too need resources to render their learning enjoyable and efficient. Often times the content of school subjects is not only removed from the experiences of the students, but it is also dull and complex. Hence the need for a variety of resources to render teaching and learning more interesting and effective. In short, we can state that teaching and learning resources are the means by which teaching and learning content is transformed to become relatively easy to understand and manage by both the teacher and the learner.

As a teacher or teacher trainer you are required to devote serious professional attention to this theme of teaching and learning resources. This chapter is intended to help you in this regard.

The chapter is divided into three units. These are:

Unit 1: Types of Teaching and Learning Resources
Unit 2: Using the Environment as a Teaching and Learning Resource
Unit 3: Developing your Own Teaching/Learning Resources for Environmental Education

At the end of the chapter, we provide you with a sample lesson.

Objectives

By the end of this chapter you should be able to:

1. Explain the relationship between the processes of learning and remembering on the one hand, and concrete and abstract concepts on the other.

2. Effectively use in your teaching various resources.

3. Demonstrate the use of technology and instructional resources to explain concrete and abstract concepts.

4. Motivate your class to use the immediate, local and distant environment as a resource.

5. Apply teaching and learning resources to teaching techniques and learning.

6. Establish making your own affordable teaching/learning resources on Environmental Education.

Unit 1: Types of Teaching and Learning Resources

A considerably large number of teaching and learning resources are available for utilisation, and they can be categorized differently. In this chapter we shall deal with five main types of resources. These are:

1. Display boards
2. Three dimensional materials
3. Graphics
4. Electronic equipment
5. People as resources

All these five categories of resources are basically **audio-visual aids**. Before we comment on each of them, let us briefly review some educational ideas about audio-visual aids and effective teaching.

QUESTION 1

What should teaching aids do for the learning of my students, and is there any evidence that students learn more if there are concrete experiences through the use of teaching aids?

What does research on learning, remembering and effective teaching say about audio-visual teaching aids? Clearly students learn better, meaning they remember and are ready to apply information, if the teacher uses teaching aids. Research on learning and remembering suggests that seeing an illustration, map, movie, filmstrip, pictures, or reading an assignment encourages remembering approximately 15% of what is seen or read. But if students were to both see and hear a lecture using a map or globe, the use ofboth audio and visual encourages 20% learning and remembering. However, 80% learning and remembering can be encouraged by students making and demonstrating teaching aids such as maps, globes, charts, pictures, posters, graphs, models, dioramas, and mobiles. In short, the more students are involved in the concrete illustration of the abstract idea they are talking about in Environmental Education, the more likely they are to learn and remember.

Concrete and Abstract

Examine Figure 7.1, the cone of experience. Note how learning and remembering is related to the **concrete,** which means something that can actually be seen, something real; and the opposite **abstract,** which means existing in the mind only, a mental image.

Does Effective Teaching Require Audio-Visual Aids?

Did you note the percentage of learning at the top of the cone where lecturing results in approximately 10% learning and remembering? Whereas at the base of the cone is 90% learning and remembering in a peer teaching situation in which students become teachers. Is there evidence that audio-visual teaching aids would help teachers be more effective? The evidence is clear, the more concrete the experience, the more likely students are to integrate new ideas into their present store of knowledge, thus understanding and retaining new ideas. You ought to conclude that most of the research evidence on learning and remembering suggest that effective teaching requires the use of audio-visual teaching aids. In particular Environmental Education because of its inherent breadth and depth, covering a whole range of concepts, needs concrete illustration which only audio-visual aids can provide.

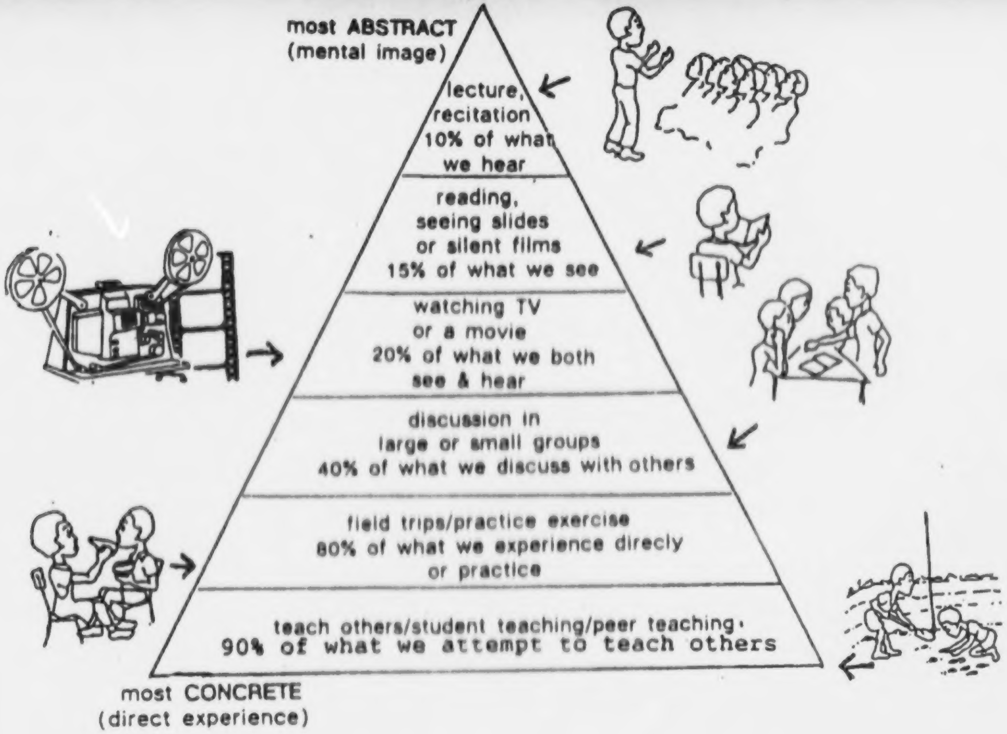

most ABSTRACT
(mental image)
lecture, recitation 10% of what we hear
reading, seeing slides or silent films 15% of what we see
watching TV or a movie 20% of what we both see & hear
discussion in large or small groups 40% of what we discuss with others
field trips/practice exercise 80% of what we experience direcly or practice
teach others/student teaching/peer teaching. 90% of what we attempt to teach others
most CONCRETE
(direct experience)

Fig. 7.1 Cone of experience as it correlates with learning and remembering

QUESTION 2

What teaching aids could I think of using to teach Environmental Education?

Before the question of what teaching aids to use, you must first be able to think about the alternative types of teaching aids that are available. Then you can plan how to select and use the teaching aids most appropriate to your class.

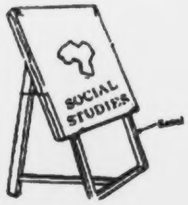
One way of classifying audio-visual teaching aids is separating them into four basic categories:

1. **Display boards:** chalkboard, flannel-board, bulletin board, poster, collage
2. **Three-dimensional materials:** models, mobile, diorama, sand table, salt map
3. **Graphic materials:** map, globe, diagram, chart, graph
4. **Electronic aids:** radio, television, tape recorder/player, opaque projector, overhead projector, slide projector, filmstrip projector, film/movie projection, computer

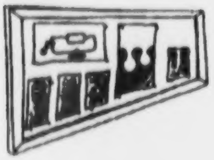
Each of these teaching aids will be discussed in terms of its advantages and disadvantages. As you read the description of each, you should be thinking of how you might use this aid to teaching Environmental Education.

Category 1: Display Boards

Chalkboard: The chalkboard is perhaps the most widely used teaching aid in the world. No special talent is required to use a chalkboard. It fits the pace of instruction, and mistakes can be easily erased. The chalkboard offers opportunity for student participation. However, work done on the chalkboard is not permanent and may be lost. Chalkboards can even be made portable to move from class to class.

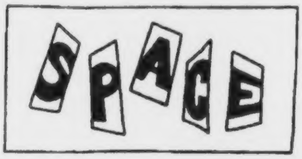


Flannel-board: The flannel-board has a rough background cloth that is usually placed on a board or hard surface. The materials that are to be displayed on the board (pictures, drawings, symbols, etc.) are backed with a rough surface and will stay in place on the flannel-board when pressed lightly. The flannel-board is easy to construct and easy to use. Children respond well to this teaching aid, and an advantage is that the display pieces can be moved around and then stored for use over and over again.



Bulletin board: Bulletin boards make excellent decorative, motivational, and instructional display areas. Boards can vary in size and shape, but they are usually made of material into which pins and thumbtacks can be stuck without damage to the board. Bulletin board displays can easily be changed. They are a good place to display student work, and students can be assigned to plan and prepare bulletin board displays as projects.

Poster: The purpose of a poster is to attract attention and deliver a message quickly. Effective posters stimulate student learning and remembering, and their construction is an excellent learning experience for students.



Collage: The collage is a form of poster using layers of specifically chosen materials. The texture and layers of materials form a symbolistic picture and deliver a message.

Activities

1. Use the flannel board as the instruction or summary in an Environmental Education lesson. An example could be "habitat". The habitat chosen should initially be a local one. Habitat could be soil, or pond, or tree or vegetable garden.

2. Guide pupils to use the flannel board around an environmental topic, such as, effects of drought, water sources, matching seeds to mature plants.

3. Students as group, decide on an environmental theme for observation. They collect relevant materials around the theme and assemble a display. They share their display with other students.

4. Guide pupils to collect materials on an environmental theme. Pupils assemble a display for others to use. Students could investigate garbage and waste management; wildlife territories within habitats; foods in the immediate environment etc.

5. Group students and ask them to design and draw-up a poster after they have investigated a local environmental issue such as soil erosion and control methods; water use and conservation; afforestation, deforestation, etc.

6. As a group, students make up a collage. To do this they choose an environmental theme. Collect published pictures/cuttings on it, make their own drawings and write factual reports on some aspects of the theme. Finally, they assemble the collage and share their display with other groups of students.

7. After pupils have studied an environmental problem, ask them to collect pictures/cuttings, draw and write so as to make a collage, as a summary of their investigation.

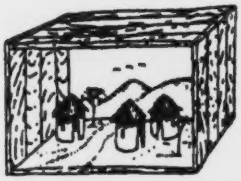
Category 2: Three Dimensional materials

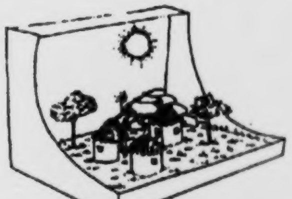
Three dimensional materials are those whose length, height and breadth can be viewed at the same time. Let us briefly comment on the main ones.

Model: A model is a representation of a real thing and can be either larger or smaller than the original that it represents. A model may be complete in detail or simplified for instructional purposes. When possible, students should be encouraged to handle and examine a model. Model construction allows students to produce their ideas in three-dimensional form.

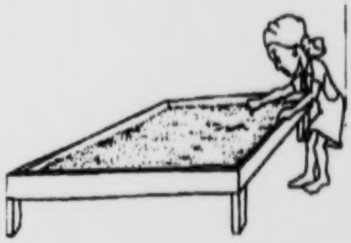
Mobile: A mobile is a moving sculpture and in most cases is a three-dimensional poster which moves, thus providing changing visual effects. A mobile usually centers on a single topic. As with many visual aids, their construction is a valuable learning experience for students.

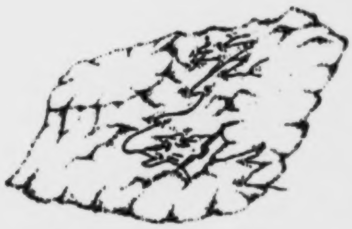
Diorama: A diorama is a three-dimensional model depiction of some scene or event. This teaching aid is usually made from a box with one side or parts of sides cut off as background. Objects to complete the scene can be constructed on paper, cardboard, or modeling clay appropriately painted and positioned in the box. Diorama construction teaches students about reproducing objects to scale and using perspective to more accurately depict a scene or event.





Sand Table: The sand table is exactly what the name implies, a table or section of the classroom floor with built up sides and filled with sand. The sand can be molded to portray the background for scene, events, or land forms, then smoothed and used over and over again. For schools with limited resources in the form of pictures and paper on which to draw, the sand table can be an inexpensive and effective teaching aid.





Salt Map: A salt map is cousin to the sand table. One cup flour, one cup salt, and one-half cup of water well mixed provides a substance that can be molded. When the mixture dries, it hardens and can be painted or coloured. A salt map is an effective teaching aid for illustrating land forms, and students enjoy making the map. Salt maps can be hung on the walls to become permanent Environmental Education teaching aids.

Activities

8. Students make a model to use in their teaching

   Examples: Make a papier-mache model

Procedure

a) Collect paper and tear it into small pieces.
b) Pound the papers and paste glue until soft to make papier-mache.
c) Mould the papier mache round a circular object. Leave to dry well.
d) Carefully cut into two parts
e) Glue together
f) Paint

9. Ask pupils to make models to place in the Display Area of the classroom around a theme, such as, man-made water-sources, ways of storing food, animals in their environment, etc.

10. Group pupils to make mobiles to display, after they have researched and investigated environmental issues. Examples are balance of nature, food chains, food webs, seasons of the year, birds in their environment, etc.

11. Students choose a theme such as a lake, river, forest, park, garden etc. They make a diorama that carries an environmental message.

12. Group pupils so that each group can design and create a diorama around an environmental issue/theme that they have investigated, such as pollution, waste disposal, habitat, activities round a water-body, food chains, etc.

13. In groups, students design a sand tray/area to teach an abstract concept, such as, water flows downhill/wards, rain falls on windward slopes, soil is deposited in other places.

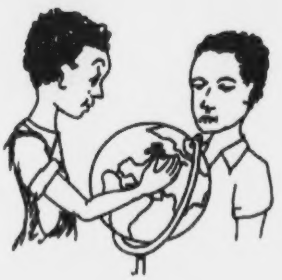
14. Ask students to model their immediate environment as a labelled map in the sand tray/area. Ask them to show direction, land forms, communications etc.

15 A salt map is a molded teaching resource. One cup flour, one cup salt and half cup water, well mixed, provides a substance that can be molded. When the mixture dries it hardens and can be painted or coloured. A salt map is an effective teaching aid for illustrating land forms and making maps.

16. Students make a salt map showing hills and valleys. Students label hills at highland and valleys as lowland. They design an activity to use the salt map, such as discussing things that are usually found in a valley, like a river, a settlement, cultivated land, etc.

Category 3: Graphic Materials

Maps and Globes Maps and globes show the position and size of countries and their relationship to the rest of the world. Flat maps can be drawn on almost any surface including the sand table mentioned above. Globes have the advantage of showing the world from any position. Globes can be produced by soaking newspapers in a thin glue solution and then layering the paper over two bowls the same size. When the paper has dried and is lifted off the bowls, the two pieces can be attached to make a ball, and continents and bodies of water can be outlined on the ball and appropriately coloured. A round calabash and other gourds can also be used as globes.



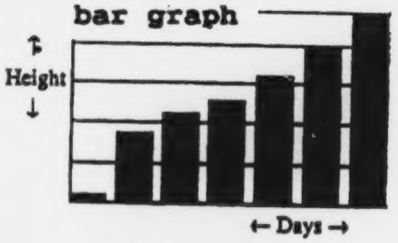
Globes can also be made from plastic rolled into a ball, woven into a ball or molded from clay or other materials.

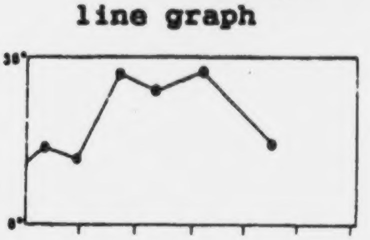
Diagrams, Charts, Graphs: These provide visual representations of abstract ideas.

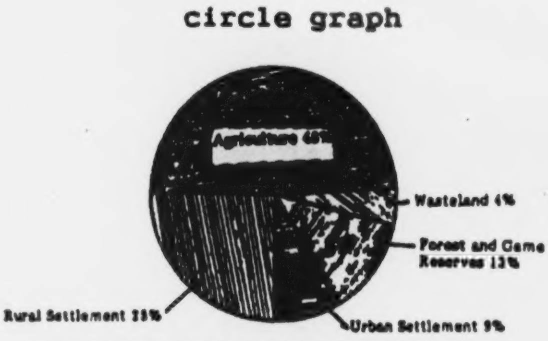
Diagrams: These are most frequently used to illustrate a structure or explain a series of steps that would be hard to visualize from just the spoken word. The diagrams we are most familiar with are those that explain how to assemble some object or piece of equipment.

Charts: These are most commonly used to show relationships. For example, a time line can visually illustrate a series of events and their chronological relationship.

Graphs: These are visual representations of statistical or numerical information. Bar, line, or circle (pie) graphs provide a visual image of percentages, quantities, growth, and change.







Land Utilisation in Central Region of Malawi

Activities

17. Students draw a map that will help them in their teaching. Remember that maps have to be presented correctly. Maps can also be sketches.

A map **must** have the following:

- Title
- A frame/border
- A key
- Compass direction indicator
- Shows scale or "not to scale"

18. **Ask pupils to draw a map of the route they take to school. Teach them the 5 essentials in map presentation. Pupils display their maps as a collage.**

19. Students draw a chart that they and you can use in the classroom. It could be about crops harvested in the school garden compared to time and money spent on the school garden.

20. Group pupils and ask them to draw up a chart showing how much water they used (and measured) to raise a vegetable crop, from seed to harvest, or amounts of water and food used to rear broilers from chicks to slaughter, or any other environmental issues.

21. In groups, students make flip-charts using sheets of paper. The flip-charts can be designed to introduce a topic and/or summarize it. Examples for flip-charts could be malaria and the life cycle of the vector; bilharzia and the life cycle of the vector; characteristics of browsers and grazers, a balanced environment, ways of controlling soil erosion, etc.

22. Students identify an environmental issue they can represent as a diagram, say a pond as an ecosystem; calendar months and weather patterns; how a windmill works; the process from cotton boll to cloth and cloth to clothes.

23. Ask pupils to draw diagrams to show various uses of different types of trees, such as foods, medicines, utensils, buildings, furniture, musical instruments, etc.

24. Students draw a bar-chart showing local rainfall, recorded over a week, a month or rainy season. This can be used for interpretation and discussion by your pupils.

25. Group pupils and ask them to keep a bar-graph over a period of time, about common illnesses that occur amongst them, such as diarrhoea, or any other environmental and/or health issue, that can be presented graphically.

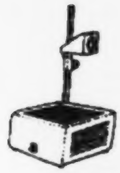
Category 4: Electronic Aids

Radio: This aid is a basic, easy to operate instrument for listening to the news and obtaining up-to-the-minute information. It forces one to visualize a picture from the spoken words or sounds from the radio. In many countries radio transmission provides long distance supplemental instruction.

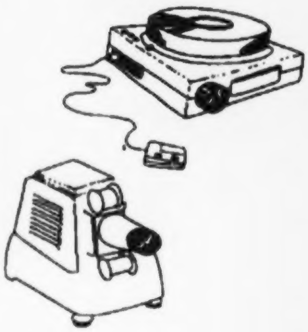
Television and Video Recorder: This aid provides both visual and audio information and news. With the recorder, programs can be recorded and replayed at an appropriate time in the lesson. However, television and video recorders are sometimes complicated and may take more than one person to operate. A television camera is an additional aid that can be effectively used to tape student performance and replayed later for evaluation. This teaching aid requires careful maintenance and storage.

Tape Recorded/Player: This is an easy to operate aid that plays pre-recorded tapes. Beyond pre-recorded programmes, a teacher can record student presentations for evaluation. Tapes can easily be erased and reused, but they do require careful storage.

Opaque Projector (Epidioscope): This projector will enlarge almost any picture or object. However, the projector is heavy and gets very warm. The room must be dark before a projected image can be clearly seen on a screen.

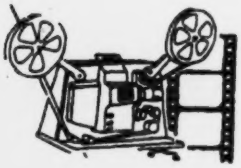


Overhead Projector: This is a popular aid that projects materials prepared on transparencies (clear plastic sheets). Transparencies can be prepared ahead of time and stored, or the teacher can write directly on the transparency which can be wiped clean and reused. A strong advantage of this aid is that the teacher can face the class while using it. A room need not be completely dark to see the projection.

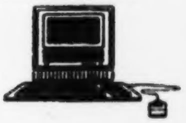


Slide Projector: Slides are attention capturing illustrations. One can regulate the pace of showing the slides to coincide with instruction, and slides can be easily rearranged or reshown. However, slides, if not properly cared for, can be lost or get out of sequence, and slides do fade over time if not properly cared for. Slides can be produced by the teacher without a camera.

Filmstrip Projector: This aid has easy to store film which always remains in sequence, and thus can never be rearranged. As with slides, filmstrip projection can be matched to the pace of instruction.



Movie/Film Projection: Films easily capture student attention. They provide scenes or events that students would never get to see in person. Films can speed up or slow down action so that a process can be clearly observed. Since films are shown uninterrupted, students must be prepared for what they are to see, and they should be provided with a related follow-up activity.



Computer: This aid provides active individual instruction at the student's pace. It gives instant feedback. The drawback is that normally only one student can use a computer at any given time, but it is an effective teaching aid, and will gain importance in the future.

Activities

26. As a group, students listen to, and tape both local and world news. They seek out any news items that relate to environmental issues and problems. Students then discuss them and make a bulletin board on them. Discuss how the issues and problems affect the local area and how they can be solved.

27. Play back the recorded tape for the pupils and ask them to listen to it and identify the news items concerning environmental issues. Discuss these issues and problems with the pupils.

    Pupils write summary reports of the discussions and pin them on the current affairs section of the notice-board.

28. Students prepare a script on a local environmental issue/problem, such as swamp

cultivation, water weeds (water hyacinth), wood fuel, etc. Record the presentations and ask other students to critique them. Everyone then re-writes and re-records their script for presentation.

29. Guide pupils on how to write a short interview script on a local issue which relates to and affects them. They play back and edit the interview. They re-record their interview.

30. If there is a film projector available, or one that can be borrowed, watch films on environmental issues. Draw up a series of questions for the students to answer and for discussion.

31. Prepare pupils to look for certain main points concerning an environmental issue/problem, to be reviewed, after seeing a film. Show pupils short films several times, focussing on different aspects every time. Students summarize various environmental issues.

32. If there is a slide-projector available, or one that can be borrowed, present a slide-film presentation, on an environmental issue/problem. Prepare your presentation as a narrative script. Students analyze and discuss both the presentation and the environmental implications of the issue presented.

33. Prepare a slide-film presentation for pupils on environment. Pupils then select slides to talk about.

34. If there is a film-strip projector available, present a film-strip presentation on environmental issues. Prepare your presentation as a descriptive script. Students discuss the presentation and the environmental issues.

35. Prepare a film-strip presentation for pupils. Prepare questions for them to answer.

36. Where possible, students view and record a television programme, about environmental issues/problems. The taped materials can be played back at a time appropriate to be viewed by other students. As a group, discuss how to present the taped materials to pupils.

People as Resources

People can be a useful teaching and learning resource. Encouraging people to help by introducing them to school programmes and processes can widen pupils learning experiences!

There are people who are specialists in their field of work, such as health workers, farmers, extension officers, fisheries officers, game wardens, museum personnel, forestry officers,development officers, herbalists and traditional healers, wood carvers, etc. Other specialists include home-makers, with skills in food preparation, preservation and storage, carpenters with skills in timberwork and making furniture, basket weavers, tinsmiths, blacksmiths, goldsmiths etc.

Teachers should always endeavour to tap the skills and experiences of human resources such as those listed above to enhance the quality and impact of their teaching.

Activities

37. Students choose an environmental theme/topic and plan the methods, techniques and strategies to achieve the identified goals. They then go and find a local person with relevant skills and experience on the theme/topic. You discuss what you are trying to achieve with your pupils. They discuss methodology and suggest a possible approach. If necessary they prepare teaching aids, for the resource person to use and agree on the length of time for the presentation.

38. Invite the resource person from one previous activity, at a particular time and on a particular day. Prepare pupils to welcome the resource person, introduce him/her and thank him/her after the presentation. Ensure that you are present to help the resource person and/or guide the pupils. Make the resource person feel at ease and see that some written work/drawings/reports, round off or follow-up the visit, so that they can be displayed.

Unit 2: Using the Environment as a Teaching and Learning Resource

The discussion in this section deals with the use of the environment as a teaching and learning resource at **two** levels, namely, the immediate environment and the extended environment.

Effective Environmental Education (EE) needs to build from creating **awareness**, inculcating **concern** and using the local situation to creating awareness of the national, regional, and global environmental issues and inter-relationships.

Taking both the local and the wider environment itself as the laboratory for Environmental Education, this part of the chapter briefly addresses the following main considerations:

1. Main categories of investigatory activities
2. Teacher's preparation for outside investigatory activities in the environment
3. Taking students outside to explore the environment

Environmental Investigation Activities

For convenience, these can be grouped into:

1. The **immediate** environment, such as the school compound, garden, orchard, pond, hedge, plant and animal habitats, etc.

2. The **local** environment, such as open areas, market places, community tree plantations, pathways and roads, rubbish dumps, waste disposal, drainage systems, plant and animal habitats

3. The **extended** environment, be this national and/or regional, such as landform, protected areas, parks, wildlife areas, botanic gardens, museums, dams, lakes, farming areas and crops, etc.

The decision as to the level and scope of the investigation to be undertaken at any given time is very much a function of the pedagogical environment within which the teacher operates.

Teacher's Preparation for Environmental Investigation

Before taking his/her students out for environmental exploration and research, a teacher is required to undertake some thoughtful preparation. Some of the tasks that will call for the teacher's close attention and action include the following:-

1. Identify the topic(s) theme(s) to be investigated

2. Explore the environment in order to establish places where students can meaningfully investigate the identified topics or themes

3. Identify and clarify exactly what the students will do in the environmental investigation

4. Decide how the investigation will be rounded off in the classroom and as/or in follow-up activities

5. Establish a **Code of Conduct** for students during outside studies.

   Among the key considerations of the code should be for example, that activities must:

   a) be designed so that the environment is not disturbed by undue specimens collection, trampling, noise and general disturbance

   b) ensure that necessary activities, such as digging into soil/compost, sample specimen collection etc are done in the most economical and least harmful way

   c) not litter or pollute the study area

   d) inculcate respect for the study area and environment as a whole.

6. If students are not used to going outside for investigatory activities, design a relatively simple activity that the whole class can do and which is easy to accomplish.

7. Familiarize students with moving from the class to the outside environment in an orderly manner.

Taking Students Outside to Explore the Environment

The guidelines that follow will be organized at three levels, namely the immediate, the local and the extended. All these suggestions assume that the teacher/tutor will have attended to the tasks that appear under Teacher's Preparation for Environmental Investigation above.

The Immediate Environment

1. Find a place outside where insects/small animals/birds are moving about.

2. Decide what pupils are going to find out. They might, for example, observe and plot (draw) movement/flight patterns and the creatures which make these.

3. Establish a Code of Conduct with the pupils and organise them in some way. Pupils carry

out the investigation outside by observing and plotting (drawing) the movement/flight patterns of the creatures that make them.

4. Decide what the pupils will do to round off their investigations and/or what follow-up activities there will be.

5. Pupils could make diagrams of the movements and drawing of the creatures which made them.

6. The work they display can later become a section of the School Environmental Education Bank.

The Local Environment

1. Students, in groups, explore an area of the local community to determine the effect of human and animal behaviour and movement on the local environment.

2. Students look at the pathways and look for such things as where pathways go? How many pathways go in one direction and/or to one place. Discuss why several paths go in one direction? Look at places where some paths end such as foodstalls, bus-stops, etc. Look for plants and where they are growing. Describe what is happening to the plant cover in the area of study. Draw a rough map and label it. Look for other human and animal effects on the environment.

3. Back in class, compile the environmental investigation into a report. Use maps, diagrams and statements. Decide as a group, what to do with your findings, so as to share them with others.

4. Later, keep your investigatory materials, for the School Environmental Education Bank.

REMEMBER

1. The environment is the **source** and **focus** of Environmental Education.

2. In teaching and learning about the environment, it is necessary to inter-link teaching techniques, teaching and learning resources and environmental resources.

3. Effective Environmental Education cannot be achieved without the understanding and application of planned correlation of these components.

The Extended Environment

1. Make a prior visit to the distant area that will be environmentally investigated by the students.

2. Make relevant arrangements to explore the place, with students, on an environmental investigation.

3. If necessary, make transport, food and accommodation arrangements.

4. Prepare for a First Aid kit to carry.

5. Decide upon a series of environmental observations/ activities that students can do as they travel through the environment, to their destination.

6. Ensure that teachers will travel with students to encourage their participation, and enhance the learning process.

Before setting out for any environmental exploration, we recommend that you and your learners, either in groups or as a whole class, you discuss the goal(s) of the investigation, as well as its objectives, and strategies to achieve them. Decide what writing, drawing, graphing or any other materials you need. Agree on some judicious sample collections to anticipate from the investigation, and how you will use them. Also discuss how you might round off your activities, so as to share the outcomes with others, and what possible application your experiences might have in your immediate, local or extended environment.

Unit 3: Developing your own Teaching/Learning Resources for Environmental Education

Given the nature of Environmental Education, it requires that teachers/teacher educators should be not only well prepared but also adequately equipped in order to be able to teach it effectively. One of the most practical way of facilitating such teaching is to develop your own teaching/ learning resources for this field.

This unit therefore will highlight some observations and suggestions on aspects of developing, organizing and sustaining such resources. The unit is organized around the sub-themes listed below. The list is not exhaustive; it is only used to offer an insight to you into what can be done, and how to go about it in this area of concern. The sub-themes are:

1. Collection of materials by teachers
2. Materials that can be made by teachers
3. Collection of materials by students
4. Resources in the field
5. A local environment trail and/or study area.
6. A variety of calendar events
7. Growing plants to beautify the environment
8. Making things from scrap

Let us briefly elaborate on each of these considerations.

Collection of Materials by Teachers

Materials can be collected by teachers in their own homes and neighbourhoods. Such things as paper, newspaper, wrappings, cardboard rolls, toilet rolls, stones, sand, clay, cloth samples, plastic bags, plastic objects, indigenous fruits, banana leaves, pieces of glass etc.

Materials That Can be Made by Teachers

Teachers make appropriate teaching and learning resources about identified and appropriate environmental themes/topics. The aids can be used repeatedly.

Teachers compile flip charts, posters, charts, work cards and collages. They can also make flannel-boards, models and dioramas. Topics can be researched and produced as accurate information for pupils to interpret, such as graphs of mean annual rainfall, altitudes in the country and pictographs of the variety of plants/ animals/birds life found locally.

Collection of Materials by Students

Students can collect the same materials as teachers. Students can also collect additional materials, such as grasses, bamboo, straw, wood offcuts, sea-shells, egg shells, feathers, variety of wrappers, candle-wax, empty match-boxes, bottle tops, jars, cans and lids, cotton reels, rubber tubing, elastic bands/elastic wire, old clocks, natural gums (glue), thorns (pins), cans, and boxes. Any useful local materials for environmental education can be collected by students.

Students can use the collected materials to make resources like straw mobiles, or plastic rain gauges.

Resources in the Field

A field study area can be used repeatedly, depending on varied goals/objectives of lessons and environmental themes or topics. One of the central goals and objectives of these field trips could be to collect information for subsequent use in the classroom. Other objectives of these field visits will include the following:

a) Reinforce environmental issues or problems that have previously been studied in the classroom

b) Practice process skills (actively do observation, comparison etc.) using the local situation, to gain first-hand information of an environmental issue/problem

A Local Environment Trail and/or Study Areas

The teacher and students can together identify and design a local environmental trail and/or study station. Such a trail or station can be used repeatedly. Work cards can be designed to encourage learning. Work cards can be revised/changed as the areas of the trail/study station change, be this seasonally, or according to various cycles and calendars of events and activities.

The purpose of a nature trail/study station must be to:

a) Arouse students interest in the local environment

b) Discover the various impacts induced by human beings, animals, birds, and plants

c) Discover inter-relationships/interdependence in ecosystems

d) Critically evaluate how activities of human beings affect the environment

e) Become aware of existing changes and predict impending changes

f) Become concerned with and involved in resolving environmental issues and problems

A Variety of Calendar Events

Six examples of types of calendar events that might be considered are listed below.

a) **A Weather Chart**

This must be sustained and changed daily (according to weather conditions).

b) **A Seasonal Chart**

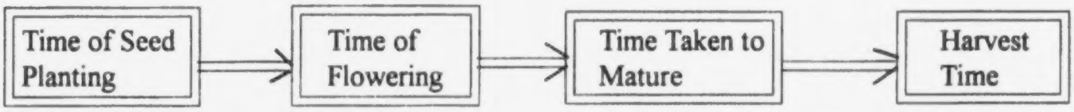
This can be developed as a frieze to which seasonal changes are added as they occur. For example, the following ideas may be represented by drawings on a seasonal chart.

Hot Dry Season and activities in the environment	Hot Wet Season and activities in the environment	Warm Dry Season harvesting activities in the environment	Cold Season and activities in the environment

c) **A Farming Calendar**

This records farming events in the local community.

Example:



d) **A Fruit Calendar**

A January to December calendar on when students observe, draw and write about the fruiting of indigenous and exotic trees. They also observe, draw, and write about the pests that attack the fruits and when they attack.

e) **A Health Calendar**

Students explore health issues in the environment.

Local Food Produce and Community Health

(i) Students keep a calendar of times of the year (seasons) when food is abundant and how these foods are used by families and/or how much local food is sold.

ii) Students keep a calendar of times of the year when certain diseases are prevalent such as diarrhoea, malaria, eye infections, asthma, coughs and colds, chicken pox, etc. Students make graphs of numbers of people that get these diseases, for their calendars of disease occurrences.

f) A Flowering Calendar

Students make calendars of the times when plants (ornamental/vegetable) trees, shrubs flower. They keep calendars of how long it takes the plants to fruit.

Growing Plants to Beautify the Environment

Plants can be grown both indoors and outside to beautify your environment. Plants can be grown for the classroom, school verandas, dining halls, etc. Indoor plants can be grown at home.

Plants can be planted in places such as on the road to school, in the school compound, outside buildings (school, office chapel) etc.

Plants have to be planted at the appropriate times of the year and properly cared for and maintained for this resource to be useful.

Making Things from Scrap

Teachers and students use materials they have collected in the environment for making teaching/ learning items from scrap. A variety of things can be made, such as:

- *Dolls* made from cloth, straw, banana fibre, woven plastic, paper.
- *Models* made from card, grass, clay, papier-mache.
- *Stuffed animals/dolls* made (sewn) and stuffed with waste materials, cotton wastes, etc.
- *Mats* made from plastic, food/sweet wrappers, straws, grass, cloth, bark, palm leaves, raffia.
- *Rigs* made from plastic, palm tree nuts, scrap cloth, rubber (old bicycle tubes) rice bags, sisal.
- *Brooms* made from scrubs, grass, palm leaves, dry twigs, straws.
- *Waste paper baskets* made from grasses, straws, twigs, plastic, sisal, old cans and other containers.
- *Cans* can be used as plant/flower containers.
- *Montage* pictures made from seeds, scraps of papers, pictures etc.

Sample Lesson Plan

Time: *Date:*

Subject: Agriculture/Social Studies/Science/Environmental Education

Topic: Soil Erosion and Control Methods

Learning Resources:

Plain manilla paper, pencils, felt pens, illustrations, pictures

Objectives: By the end of the lesson the pupils should be able to:

1. Identify places in their local environment where there is evidence of soil erosion.
2. Describe types of erosion from pictures/diagrams
3. Describe control measures for the different types of erosion.
4. Design posters which depict types of erosion and control measures.

Introductory Activities:

The teacher reviews the previous lesson and then introduces the new one.

Development Activities

- Take pupils out to observe places where erosion has taken place.
- Back in class the teacher generates a discussion on what pupils observed.
- The teacher uses pictures or diagrams to generate a discussion on other types of erosion.
- Show pictures/diagrams of erosion control measures to the pupils.
- Guide pupils to describe the control measures for different types of erosion.
- Groups the pupils and let them appoint group leaders.
- The teacher provides the groups with materials needed to design their posters.
- Assign each group with a type of erosion and control measures to work on.
- The group[s] design their posters.
- Each group presents its poster for discussion.
- The posters are then pinned on the display board.

Concluding Activities:

Ask questions which relate to the objectives. The following are examples of such questions:

1. Where in the environment do we have evidence of erosion?

2. Describe the following terms:

   i) Sheet erosion
   ii) Gully erosion
   iii) Rill erosion

3. What measures are used to control each type of erosion?

Lesson Review

In the introduction, ask some questions on the previous lesson. This helps the pupils to link the lesson to the new one and to test how much of the previous lesson they can remember.

In the development of the lesson, use a variety of activities for different reasons. These are:

1. Observation of an area where erosion has taken place. This helps make the learning real.

2. Class discussion for the pupils to generate ideas and enrich their understanding.

3. Group tasks - the groups brainstorm and design appropriate posters arising from the discussion.

4. Presentation of group findings to facilitate an overall understanding of types of erosion and control measures.

Pupils Evaluation

Ask questions about general pupils' performance. The questions should test a wide variety of thinking levels and attitudes.

Examples are:

1. What measures would you suggest to be taken to control erosion in your locality?

2. How can erosion be prevented?

3. How would you go about organizing the rehabilitation of an area that has been eroded?

Self Evaluation

Ask yourself questions about the Lesson.

Examples of such questions could be the following:

i) How well did I guide the pupils to learn from the environment?
ii) How did I guide the pupils' description of types of erosion and control methods?
iii) How well did I guide the pupils in the presentation of their posters and subsequent discussions?
iv) What methods did I use to evaluate the pupils' posters?
v) How manageable were the tasks set?
vi) How involved were the pupils in doing the tasks?

References

BATH, James L. - Methods of Instruction in Social Studies, 3rd Edition, London, New York.

MALAWI Institute of Education - Audio-Visual Handbook

UNESCO - Environmental Education: Module for Pre-service Training of Science Teachers and Supervisor for Secondary Schools. (Module 7).

UNESCO - Environmental Education: Module for Pre-service Training of Science Teachers and Supervisor for Primary Schools. (Module 5).

ASESP - Curriculum and Instruction Series in ASESP Social Studies Curricula and Methods.

UNICEF-UNESCO-ASSP - Module for Environmental Education Including Population Education.

ASSP: Source book on Teaching/Learning About the Commonwealth Through Social Studies in Africa (Users' Guide).

CHAPTER EIGHT

CLASSROOM EVALUATION OF ENVIRONMENTAL EDUCATION

Introduction

Teaching in some ways can be compared to manufacturing; it uses inputs (resources) and produces an output (product). In chapter seven we discussed some of these inputs. Now we need to point out that the students (better citizens) are the output of the education process. As a teacher involved in this production process you need to know how well you are working and how good your products are. You also need to know if the expectations of your bosses (like the directors of a manufacturing enterprise) are met by your work. You can only get these judgements if you evaluate your work and your students. Therefore evaluation is necessary because it is a **quality control** process which reveals the quality, quantity and type of knowledge, skills and attitudes our students have acquired. Evaluation is also the teacher's **gesture of accountability** to:

1. The **students** whose future is being shaped
2. The **parents** who entrust their children to the teacher
3. **Society** which seeks to improve itself through better education for each successful generation.

These are the **stakeholders** of education; they are comparable to stockholders (shareholders) in an enterprise, and you are answerable to them. To enable you to meet that challenge in the area of Environmental Education, this chapter will discuss the meaning of evaluation, what you should evaluate, when and how you can do so, and the ways in which you can use evaluation information.

This is yet another chapter that is addressed to you as a teacher. However, it all along suggests lessons and activities which tutors in teacher colleges are strongly advised to involve their students in.

Objectives

By the end of this chapter you will be able to:

1. Define evaluation
2. Choose what to evaluate
3. Design and use evaluation instruments
4. Schedule evaluation activities logically
5. Utilize your evaluation information to improve teaching, learning and student performance.

Unit 1: The Meaning of Evaluation

Unit Objectives

The students will be able to:

The students will be able to:

1. **Identify the components of evaluation**
2. **Distinguish the terms measurement, test, assessment and evaluation**
3. **Explain the meaning of evaluation**
4. **Explain the relationship between measurement, test, assessment and evaluation**
5. **Identify instruments which are used for observing the attributes or characteristics and behaviour of the learner.**

Measurements, Tests, Assessment and Evaluation

It is very common for teachers to use the terms **evaluation**, **assessment**, **tests,** and, much less, **measurement** freely and interchangeably. They also often equate them with **ranking.** Evaluation is not assessment; it is not testing either, nor is it measurement, and is certainly not synonymous to ranking. However, it does involve some combination of these elements and, at times, all of them. We need to make this clear by defining each of these terms.

Measurement

This is a **quantitative description** of your students' performance, behaviour, or events in which they are involved. Measurement is simply a process of collecting data on which generalization and judgement will be based. For example, an objective type question is a **tool** of measurement. However, engaging in measurement is not, in and of itself, evaluation; it can only be part of evaluation. Another tool of measurement is a test. This is a paper and pen tool composed of several questions that determine mastery of what has been taught.

Ranking

In education, like in a race, ranking is the assigning of numbers to students in respect of some aspect in comparison with others and according to specified criteria. For example, a student who is strong in science and weak in arts may be ranked as follows after terminal examinations:

Subject	Marks %	Rank
English	50	15
Mathematic	85	2
Science	90	1
Agriculture	72	4
General Knowledge	42	21

When the class teacher totals the marks of each student, the student may be ranked first in the class. What these numbers or ranks mean is that if the examinations were race tracks these are the positions which the student would occupy relative to other competitors.

Assessment

The word 'assess' means to 'sit beside' or 'to assist' a judge. In education the word assessment refers to the gathering of data and putting them into an interpretable form so as to reflect **performance** or **achievement**. For example, a combination of measurement and ranking is an assessment process.

Evaluation

The word **evaluation** used in education means the "judging of the **worth** of an event, process, someone or something". Systematic educational evaluation involves formal appraisal of quality. It is a process by which quantitative as well as qualitative data are processed in order to arrive at a judgement of worth, value, or effectiveness, with a view to making a decision and taking some action.

In evaluation, the data from assessment, tests, measurements, or any other objective information are integrated in order to come up with a value judgement. Evaluation is therefore a comprehensive analysis of student performance, materials, the teacher, and so on. The close relationship of evaluation with measurement, ranking and assessment is illustrated in the table below.

Table 8.A: The Relationship Between Evaluation, Measurement, Ranking and Assessment

Statement	Category
Sophia **scored** 95% in the examination.	Measurement
She **topped** in the whole country.	Ranking
She scored **distinctions** throughout and a **first grade.**	Assessment
Sophia is an **excellent** student and good **university material.**	Evaluation
She has been offered a full sponsorship **scholarship.**	Decision/action

Assessment, measurement, tests, or systematic evaluation procedures are the means teachers use in education to ascertain the extent to which institutions have been effective by finding out what pupils have acquired. It is also the means used to evaluate the quality, effectiveness, and efficiency of education programmes, curriculum as well as the quality of instructional methods being used in schools.

Activity: Definitions

1. Divide the class into groups and ask them to have their dictionaries ready for use.
2. Distribute handouts of test questions, checklists, rating scales and interview schedules as example of measuring instruments.

(a) Ask the students to work in their groups and do the following:

   (i) Write in their own words, the meaning of the terms test, measurement, assessment and evaluation

   (ii) List the differences among these instruments.

(b) Group present their differences definitions and observations.

(c) Explain to the class, the meaning of the terms they have been attempting to define.

(d) Discuss with the class how evaluation depends on assessment data from the process of measurement in which the instrument they have just reviewed might have been used.

e) Summarize the activity by asking the students questions on its main points.

Unit 2: What to Evaluate

Unit Objectives

By the end of this unit you should be able to:

1. Select aspects that you need to evaluate
2. State reasons why each of those aspects should be evaluated.

Target of Evaluation

In a way we have already mentioned some of the aspects that teachers often evaluate. But, of course, the list of things that can be evaluated is too long to be exhaustively discussed here. Therefore this unit will try to limit its discussion to those aspects that are likely to be of immediate relevance to classroom situations.

As a teacher you will probably want to evaluate the following:

- The quality of your teaching (yourself)
- The quality of students' learning (students)
- The teaching resources (materials)
- The curriculum (syllabuses and schemes of work)

Evaluating Your Teaching

In a broad sense you can evaluate yourself. Of course you can and should involve your students in such an exercise. To evaluate your teaching, you will usually focus on the techniques you use and how effective they are. You will also find it useful to know what your students think of each technique or even what they think of you, your teaching abilities as well as personality in the classroom.

The purpose of evaluating your teaching is to test for its appropriateness and effectiveness. This can be done by an examination of:

- Your techniques and learning activities and
- The teaching/learning environment in which you operate

What is important in evaluating any teaching technique is that you choose variables that are both observable and measurable. For example, variables like time, costs, comparison of students' learning levels, etc, may lend themselves well to the evaluation of teaching techniques.

The immediate learning environment, on the other hand, is the classroom and its facilities. However, the school and the community outside as well as the state of the environment in the locality constitute wider but important components of the learning environment. You need to find out if they are actually aiding your teaching and your students' learning and how much they do so.

Evaluating Your Students

During your teaching you expect your students to acquire some knowledge, learn certain skills as well as develop values and attitudes. The best way to evaluate all these aspects is to do so against the objectives of the course or lesson.

In the evaluation of environmental knowledge there should be a part devoted to recall of course or lesson content. However, you should be careful not to let this focus dominate your evaluation of the content aspect in the learning process. Limit attention to it to only 15 to 20 percent of the entire evaluation. That way you might be able to balance evaluation of other very important aspects of learning, such as comprehension/understanding, application and realization.

In Environmental Education you are expected to teach your students some specific skills, and these should be evaluated. Of course knowledge and skills should not be taught separately. They should be complementary to each other, although it is quite acceptable for you to tap them separately in your evaluation.

Since in most curricula in Africa, Environmental Education is or will most probably be integrated into existing subjects, we shall offer here three sets of skills which you should seek to teach and evaluate, namely environmental education skills, social studies skills and science skills.

Table 8.B: Some skills to be taught in Environmental Education

Environmental Education Skills	Social Studies Skills	Science Skills
1. **Problem/Issue Identification** - The ability to recognize from direct experience or audio-vidual or print media, some apparent impact, threat, or risk to the environment.	1. Encouraging **Observation and participation** in the school and community.	1. **Classifying** - comparing, sorting, grouping, and/or ordering objects, organisms, events, or data on the basis of observed properties.
2. **Problem/Issue Definition** - The ability to generate or synthesize a summary of the problem or issue in narrative, chart, and/or pictorial form.	2. Dealing with **critical issues** and the world as it really is	2. **Predicting-** Forecasting conditions or events on the basis of past observations and/or inferences.

Environmental Education Skills	Social Studies Skills	Science Skills
3. **Problem analysis-** The ability to break a complex problem into simple, clear components, including the source/location of the problem, the input or systematic activity that causes it, and its impacts.	3. Preparing students to make **decisions** based on **democratic ideals.**	3 **Formulating and Defining Problems-** Recognizing and stating a problem (e.g. a distinct risk or threat, impact, discrepancy, or new perception).
4. **Issue Analysis-** The ability to recognize the parties at issue, the positions each party takes, their stated or apparent rationales, and the values implied in these positions or rationales.	4. Encouraging **citizenship participation** in public affairs.	4. **Identifying Variables-** determining the distinct factors or conditions that may reflect patterns in a given situation.
5. **Primary Problem/ Issue Investigation-** The ability to use sampling, survey, and questionnaire techniques to collect primary data on a problem	5. **Data-gathering skills-** Learning to acquire information by observation and compiling, organizing and evaluating information.	5. **Posing Answerable Questions and/or Testable Generalizations** about specific variables, conditions, relationships, causes.
6. **Secondary Problem/Issue Investigation-** Collection and use of audiovisual and print material to investigate a problem/issue.	6. **Intellectual skills** Comparing ideas, events, and situations on the basis of similarities and differences, grouping items in categories, asking appropriate questions, drawing conclusions from evidence, arriving at general ideas	6. **Designing an Investigation-** Formulating a plan or set of procedures for investigating particular questions or hypotheses.
7. **Problem/Issue Evaluation-** Based on a synthesis of the primary and secondary sources, the ability to draw a tentative conclusion about the nature, magnitude and importance of a problem or issue.	7. **Decision making skills-** Learning to consider alternative solutions, considering all the consequences of each solution, making solutions and justifying them according to democratic principles, acting on those decisions.	7. **Conducting an Investigation-** The purposeful execution of a descriptive or experimental investigation.
8. **Identifying Resolution Strategies-** The ability to identify a range of strategies that a citizen can take to resolve the problem or issue, including persuasive, political, and a legal action and direct management of natural resources. Identify which strategies are applicable and most likely to succeed with the problem or issue at hand.		8. **Collecting Data-** Collecting qualitative and/or quantitative observations with respect to particular objects, organisms, or events.

Environmental Education Skills	Social Studies Skills	Science Skills
9. **Planning for Resolution of the Problem/Issue**- The ability to select one or more strategies to address the problem or issue. Includes identifying resources needed, allocating resources and sequencing activities over time. 10. **Implementing a Resolution**- Ability to carry out an action plan, to practice the skills needed to carry out the planned strategies. 11. **Evaluating Each Step**- A planned action should be evaluated before, during, and after its implementation. This skill includes evaluating personal values in relation to the problem or issue.	8. **Interpersonal skills**- Learning to see things from the point of view of others, understanding one's own beliefs, feelings, abilities, shortcomings and how they affect one's relations with others, using group generalizations without stereotyping and arbitrarily classifying individuals, working effectively with others as a group member, giving and receiving constructive criticism, accepting responsibility and accepting the rights and property of others.	9. Analyzing and **Interpreting Data**- Searching for and identifying a pattern(s) and one or more data sets using recognized data analysis procedures. 10. **Drawing Conclusions**- Forming tentative generalizations from interpretations of data.

It is quite difficult to evaluate values and attitudes, and most teachers shy away from this concern which is particularly important in Environmental Education. This is rather unfortunate because our attitudes as well as personal and group values have a strong bearing on how we use resources in our environment. If you have not been evaluating your attitudes and values or those of your students, it is time that you started to do so. But then, you may ask, what are attitudes and values?

An **attitude** is a position, feeling or disposition with respect to somebody or something. It is a tendency to act for or against something. Usually it is reflected in the statements that we make about certain things and issues. For example, some of the statements we make might suggest threatening negative attitudes to the environment while others suggest supportive positive ones. Therefore you should always look out for positive and negative attitudes in your students when they make statements about the environment. Those statements will be indicators of your learners' attitudes towards the environment.

In its ordinary sense, the word **value** means **worth** or price that is attached to something. As educators we define **values** as aspects to which individuals or communities attach a high level of **worthiness** or those that they hold in high regard. Our thinking and feelings about issues like the role of women, parents-child relationship, conservation, and so on constitute our values towards these particular concerns.

The individual's or community's total collection of cherished ideas is called a **values system.**

Values are important to you as a teacher. If students cannot identify environmental aspects as

ideas, then the environment is unimportant in their values systems. They are therefore unlikely to promote environmental prudence. For this reason every teacher should make an effort to evaluate their students' values.

Evaluating Teaching Resources

As we noted in chapter seven, the use of teaching and learning resources is meant to improve teaching and learning. Both teaching and learning need to aim at generating knowledge, skills, values and attitudes. Considering these two points, you should try to find out whether the resources/ materials you use for teaching contribute to the teaching of knowledge and skills as well as to the development of values and attitudes.

You also need to know about other aspects. For example, do the students like or enjoy using the materials? Do they find them easy or hard to use? Are the materials affordable and durable, easily accessible or easy to make? Above all are they relevant to environmental concerns and needs of the community?

Evaluating the Curriculum

A **curriculum** is everything that is done, taught and learned in a school, or an education programme for the purpose of enhancing and developing of personal faculties and potential. The term curriculum may also be defined in a variety of other ways. The narrowest definition of the term is that it is a course of study. A syllabus, textbook or a list of objectives are therefore often referred to as part of a curriculum.

The evaluation of the curriculum means the determination of its quality. This means that evaluation should help to discover whether or not it has the characteristics of a good programme. The following are some of the characteristics to look for:

1. Objectives

    - presence of objectives
    - objectives stated in observable terms
    - objectives reflecting conditions relevant to society
    - objectives to be learner-centered

2. Content

    - availability of content
    - learnability of content
    - authenticity of content
    - relevance of content to the society

3. Teaching-Learning Activities

    - availability of suggested activities
    - relevance of the suggested activities
    - balance of the activities
    - adequacy of the activities
    - resources/illustrations

- an indication of the availability of the resources
- relevance of the resources and illustrations.

4. Suggested evaluation

- an indication of the need to evaluate the curriculum
- suggested criteria for evaluating the curriculum

Usually a curriculum is evaluated by the Ministry of Education or the curriculum development center. Nevertheless, teachers themselves have a responsibility to send constructive feedback to these authorities regularly; that is, whether they are requested to do so or not. Therefore you need to have some broad ideas on the evaluation of a curriculum.

Activity: *What to Evaluate*

In this activity you will study and analyse an extract of one teacher's scheme of work with a view of identifying what the teacher aught to have evaluated.

Procedure

Study the extract of the scheme of work below which was prepared by a social studies teacher and do the following:

1. Formulate objectives for this part of the course.

2. Identify the aspects which the teacher aught to evaluate and list them under the following headings:

    a) The teacher/teaching
    b) The student/learning
    c) The resources/materials
    d) The curriculum/course

The Scheme of Work Extract

Introduction: This is a social studies course unit made up of five lessons. It is an attempt to promote the teaching of values, skills and attitudes by manipulating content rather than teaching the latter as an end in itself. These materials further try to break the tyranny of the textbook. As will be seen, several sources of information are used; the textbook is just one of these. Emphasis in these materials is laid on learning through discovery.

Goal: The goal of this course unit is to promote environmental awareness through teaching about vegetation and to develop in the learners the values and attitudes necessary for commitment to the conservation cause and, generate personal initiatives for environmental action. It will also make an effort to teach useful learning skills.

Unit Theme: **People, Vegetation and Development.**

LESSON TOPIC/ PROBLEM	TO BE LEARNT	RESOURCES
Lesson 1- classroom lesson Environmental or Ecological zones Why do vegetation types vary from one area to another?	Skills · Describing · Correlating phenomena (using pictograms) Concepts Ecological/ Environmental Zone Environmental/adaptation	Atlases Drawing materials Physical geography textbook Outlines of charts/graphs
Lessons 2&3- Field Survey The value of vegetation. In what ways is vegetation related to our lives and the state of the earth?	Skills Observing Interviewing Recording data/information Processing data/information (inference and deduction)	Biology textbook The surrounding environment The community
Lesson 4 - Classroom role play Conservation of forests Should forests be preserved or exploited?	Skills Critical thinking Debating Decision-making Concepts Preservation Exploitation Conservation	Two written speeches Dictionaries
Lesson 5- Classroom discussion Environmental Action What can we do individually to conserve vegetation?	Skills Values clarification Planning action Concepts Environmental action Community involvement	Class-notes Charts prepared during earlier lessons

Unit 3: How to Evaluate

Planning Your Evaluation

A comprehensive evaluation of student learning must be planned well so as to cover both **knowledge** and **understanding**.

Knowledge of something is awareness of its existence, and acquisition of basic facts about it. Understanding, which is a cognitive level of learning is more refined and involves comprehension of the working of the structural components of something; for example comprehension of the processes of interrelatedness and applying principles in other situations.

When you plan to evaluate knowledge you want to know how much the students can **remember/ recall**. Alternatively you may want to find out whether students can **recognize** the facts or concepts you taught if they are presented to them. Therefore the instruments that you use will test memory, in other words rote learning.

However, since Environmental Education is much more than rote learning, you must plan to evaluate understanding. The process of understanding involves **comprehension**, **application** and **realization**. These are often called **thinking skills**. Table 8.C summarizes the aspects of student learning that you should plan to evaluate in Environmental Education.

Table 8.C: Processes of student learning to be evaluated.

CATEGORY	COMPONENTS	RELEVANT ABILITIES
KNOWLEDGE	a) Recognition	The ability to *select* the correct form of the required knowledge from other incorrect or unrelated forms. It is the ability involved in answering multiple choice questions at the *remembering* level.
	b) Recall	The ability to *reproduce* the correct form of required knowledge. It is the ability involved in answering open-ended questions at the *remembering* level.
UNDERSTANDING	a) Comprehension	The ability to *explain* the meaning of required knowledge, or to *select* the correct explanation.
	b) Application	The ability to *use* knowledge in a practical way.
	c) Realization	The ability to: *integrate* new knowledge with previously acquired knowledge; and *use knowledge creatively* to generate original thought.

When you plan to evaluate student learning, you must remember that environmental knowledge has several dimensions. Both your teaching and evaluation should try to balance them. These dimensions include:

1. **Location/Distribution (Spatial)**
   Those concepts concerned with the location and distribution of people and resources on the earth's surface.

2. **Time /Change (Chronological)**
   Those concepts concerned with time and change through time.

3. **System/Organization** (Structural)
   Those concepts concerned with structure and organization of societies, systems, groups and institutions.

4. **Process/Function** (Functional)
   Those concepts concerned with the way in which societies, systems, groups and institutions work and function.

5. **Interaction/Interconnection** (Casual)
   Those concepts concerned with the relationships between elements within societies, systems, groups and institutions, and with the relationships between events.

Bearing in mind the categories of learning processes and the knowledge dimensions indicated above, you can prepare an item distribution grid to help you spread out your items fairly well when you are planning to evaluate students learning. It would look like table 8.D

Table 8.D: Evaluation item distribution grid

Dimension	1.(a)Recognition (b) Recall	2.Comprehension	3.Application	4.Realization
1.Location/ Distribution (spatial)				
2. Time/Change (chronological)				
3. System/ Organization (structural)				
4.Process/ Function (functional)				
5.Interaction/ interconnection (casual)				
6.Individual/ Person (personal)				

<----Rembering--------><--------------Understanding------------------------------>

Activity: *Constructing an Item Distribution Grid*

In this activity visualize yourself as a science teacher who has incorporated Environmental Education in your teaching. You have reached the unit on 'Ecosystems' in your scheme of work and you are now planning to give an examination/test at the end of the unit. Our chosen ecosystem is a swamp forest near the school.

1. Study the following unit objectives and classify them under the headings:

    a) recall/recognition
    b) comprehension
    c) application
    d) realization

Objectives

By the end of the unit students will be able to:

a) Identify the components of the ecosystem.
b) Explain with the aid of a diagram the interrelationships among components of the ecosystem.
c) List the components of the biosphere.
d) Make decisions based on four environmental issues.
e) Prepare a plan for a field study of a farm or factory.
f) Assess the socio-cultural aspects of the community to their environment.
g) Develop the ability to solve problems on the basis of EE data collected from a field study.
h) Apply the findings of a food web in one habitat to another.
i) Record reports from fieldwork activity.
j) Investigate whether all life supporting elements are crucial for plants to live.

2. In your scheme of work you have listed the following topics to be taught and you want to examine on each of them in a 30 item test. In the outline table below mark with asterisks (*) the topics you will use to evaluate student learning at the various thinking levels. Your choices must be consistent with your stated objectives.

Table 8.E: A form for evaluating students' learning

RG= Recognition RC=Recall CP= Comprehension AP=Application RL=Realization

	Content	RG	RC	CP	AP	RL	TOTAL
1	Human interventions						
2	Components in the ecosystem						
3	Effects of climate on ecosystem						
4	Food Web						
5	Socio-cultural aspects in relation to forest and other resources						
	TOTAL						

3. Finally, prepare an item distribution grid similar to Table 8.D and indicate precisely how you would distribute the questions in the test as to cover all the thinking levels and all the dimensions of Environmental Education. Remember to lay more emphasis on understanding.

Evaluation Techniques and Instruments

It is not possible or even necessary to describe all the available evaluation techniques and instruments that you can choose from. We have found it to be more practical and time effective to discuss only six evaluation techniques here and encourage you to expand your range through further reading. These are:

1. Classroom observation
2. Interview
3. Checklist
4. Creative formats
5. Content questionnaire
6. Written test.

Each of these techniques has a specific aim or application, but you must make sure that both you (teacher) and the students take an active part in any one that you choose to use (see table 8.F).

Table 8.F: Main aims of selected evaluation techniques

TECHNIQUE	MAIN AIMS
Interview	To provide a way to listen from children by stepping out of the role of teacher, so that better teaching becomes possible. To give youngsters the opportunity to express verbally and in depth their use of the ideas of the course and their feelings about learning. To enable children to criticize their own learning, to give them some power over their own education.
Classroom Environment Checklists (Opinion Surveys)	To provide feedback to the teacher about the classroom environment. To provide the children with a common format of considering the materials and activities of the course, for thinking about personal learning preferences, and for evaluating the climate in the classroom; to give the class the opportunity to influence their future instruction.
Creative Formats	To encourage expressions of children's imaginative and creative work. To give the teacher one framework for exploring children's understanding of the course, as expressed in their creative responses to it. Such responses involve both deeply felt personal creations and more integrative projects that combine elements and methods of the course into the student's own work.

Content Questionnaire	To encourage children to organise their thinking around conceptual problems, vocabulary usage, personal interpretations of the meanings in the course, and to exchange their thinking with one another and the teacher. To provide the teacher with a format for diagnosing children's difficulties with course topics and reviewing information gains and concept mastery.
Classroom Observing	To provide the teacher with a method for reflecting about classroom events and activities, the teacher's role in setting the tone and style of the class, and the aims and results of teaching methods. To provide a basis of information for change in teaching strategies.
Written Test	Test the ability of students to organise and effectively present ideas in writing. To provide the teacher with an opportunity to detrmine how much and how well the learners have learnt. To provide a basis for a variety of decisions, such as what to teach next, and how to teach it, grading and promoting students to the next level

In the following few pages more observations and suggestions are provided in respect of each of these techniques and instruments.

Evaluation by Interviewing the Students

Through interviewing the students on various aspects of your teaching such as content and materials, you can afford the students a chance of self-expression. Such an opportunity may also be your only access to frank opinions from the students. These benefits will be enjoyed if the following NOTES of caution are born in mind.

1. Design and ask relevant, clear and simple questions that are appropriate to the grade and age.
2. Be a sympathetic, interested, friendly and attentive listener.
3. Be neutral to avoid influencing the interviewee's opinions and responses.
4. Encourage frankness by allaying fears of self-exposure and self-betrayal by the interviewee.
5. Avoid trying to survey the entire population (class or school); devise some sampling approach.

Once the interviews are completed the results have to be analyzed to ascertain the following:

- Individual reactions to the material and activities to which the course has exposed them
- Group interactions and social learning
- Level at which concepts have been grasped

This method of evaluation should be continued through all the grades and subjects. In the early 3 to 4 years of primary education it taps the value of innocent frankness, while in the latter years, it helps to develop an acquiring mind, originality, objectivity, and maturity of thought during dialogue.

Evaluation by Checklists

A checklist is simply a list of items, such as opinions, techniques and activities, with instructions to the respondent to check, tick or cross against a pre-determined number of preferred items.

Given a checklist, each question has its own alternatives (options) and for any single survey, the questions should form a coherent whole relating to the course or part of it. There is need for you to state the objectives of the survey.

Given on the next page is an example of a checklist adopted from an American book, *Man: A Course of Study*. You could complete the list by inserting the name of the course and providing some items on the course or theme or sub-theme you have covered.

Evaluation by Creative Formats

Creative Formats are a technique through which you can discover how much learners are able to use content material of the course to create situations of their own imagination in the field of creative arts. The following are the fields in which the learners could reflect understanding of course content and concepts as well as development of attitudes:

- art: drawings, paintings, sculptures
- stories: written and oral
- songs
- drama and
- poetry

After the assessment of each work, a selection of these may be displayed on the notice-board or even included in the school magazine as a rewarding measure. What is of particular importance, however, is the idea of balancing the course material and the creative work. Artistry must not be allowed to overshadow the course evaluation intentions of the whole exercise. However, this notwithstanding, evaluation by creative formats can be more effective if the teachers of the creative arts, e.g. literature, drama and art, lend a helping hand.

Evaluation by Content Questionnaire

Questionnaires are an effective instrument of evaluation for decision-making relating to remedial action. They may also be used as tools of developing ability to identify relationships among various aspects of the content material.

As an evaluation technique, the questionnaire is a diagnostic tool to show whether the learners have learnt conceptual problems, vocabulary use, and personal interpretation of meanings in the course.

A content questionnaire may start as suggested on page 134 and continue as determined by the evaluators.

OPINION SURVEY ON THE.......(name of course or topic)

.... Section (State title of the section of student)

Name:..................................

Date:..................................

The following questions ask for your opinions about [the course]. This is a chance to think about what you have been studying and how you feel about the class. After you have answered the questions as honestly as you can you will be able to share your opinions with your classmates to find out how they feel and how they best like to learn.

1. To describe my class during the ....section. I would use the words (check **2** answers)

______________________ easy
______________________ confusing
______________________ makes me think
______________________ fun
______________________ hard
______________________ not very important
______________________ my favorite subject
______________________ boring
______________________ other (Name it)

The dotted lines have been used in the places where you or the course evaluator is expected to insert the name of the course or the theme being evaluated.

2. While studying the .... material, I liked to work best: (check **1** answer only)

__________________ alone
__________________ with one friend
__________________ with the teacher's help
__________________ in a small group
__________________ in one big group, the whole class

3. When studying the .... section, I found it hard to: (check **3** answers).

__________________ understand the opinion of others
__________________ draw pictures
__________________ discuss with my classmates and teacher
__________________ understand some of the booklets
__________________ understand the pictures, slides, films
__________________ do written work

QUESTIONNAIRE ON WILDLIFE CONSERVATION

Name...............................

Class..............................

Date...............................

This questionnaire gives you an opportunity to REVIEW SOME of the information in the chapter on wildlife conservation. You will also have the chance to think about the main ideas of the chapter on this topic. Hopefully, this will be as exciting to do as it will be useful in refreshing your mind on the subject. It will be more fun when you and your classmates discuss your various answers. Remember that this is not a test or examination. After responding to this questionnaire, work with another student to check and discuss your answers using the textbook and your own notes.

Self Check Exercise

1. What does the term **wildlife** mean to you?

2. Name **the Ministry** that is responsible for wildlife matters in your country.

3. State two **environmental reasons** why wildlife must be conserved.

4. Give two **economic reasons** for conserving wildlife in your country.

5. etc.

Content questionnaires should be varied so as to include different objectives and types of questioning such as true-false, agree/disagree, multiple choice, and short answer questions. Such a variation does not only afford you flexibility and wider coverage, but above all, it offers greater challenge to the respondents. It would therefore be a useful exercise to use the sample questionnaire just to construct more varied formats.

After the students have responded to the questionnaire, you should check the areas of difficulty that require remedial action.

The usefulness of a content questionnaire is not limited to evaluating at the end of a unit or course. It is a very useful technique of deciding what areas you need to lay more emphasis on during your teaching. You can do this by administering the questionnaire **before** teaching a unit. The same questionnaire is then administered after the unit has been taught. This strategy is known as **pre-test** and **post-test** investigation. If better knowledge of the content is revealed during the post-test, you can credit this improvement to the teaching/learning processes your students have experienced. The pre-test and post-test strategy is even more useful in Environmental Education if the questionnaire includes items that can serve as indicators of students' values and attitudes.

Evaluation by Classroom Observation

Classroom observation is mostly used as an informal and effective evaluation technique. Properly utilised, it can be used to evaluate yourself, the course and the students - all at the same time, with amazing results. But as Kevin Piper cautions, it is subject to the vagaries of memory.

Nevertheless, it must be acknowledged that knowingly or unknowingly we have to and always do use observation to arrive at judgements which feature on students' terminal reports, conduct, certificates, career guidance records, or even in courses themselves.

Table 8.G below illustrates how you can use student classroom behaviour to estimate chances of learning and effectiveness of your teaching.

Table 8.G: Observable group behaviour and their possible implications.

OBSERVABLE BEHAVIOUR	IMPLICATIONS FOR LEARNING	IMPLICATIONS FOR TEACHING
Negative behaviours		
1. **Active non-participation** Actively disrupts work of groups, wanders around, disturbs or distracts others.	Unlikely to learn Hinders learning of others	Could be uninspired or resented for some
2. **Passive non-participation** Present in name only. Non-disruptive but uninvolved. Fiddles, doodles, looks at ceiling,gazes through windows.	Unlikely to learn	May be boring May be ignoring student's problem or inclination
3. **Passive participation** Listens but not contribute.	May occur, but not assured	
Positive behaviour	Learning is likely to occur	Perhaps does not cater for shyness
4. **Active participation (co- operative)** Co-operates willingly in group activities, but does not make suggestions or initiate activities.	Ditto	Accepted but not inspiring

OBSERVABLE BEHAVIOUR	IMPLICATIONS FOR LEARNING	IMPLICATIONS FOR TEACHING
5. **Active participation (initiative)** Makes constructive suggestions, takes a lead in group activities.	Ditto	Inspiring
6. **Active participation (directive)** Assumes leadership of group, organizes others, directs group activities.	Ditto	Ditto

Evaluation by Written Tests

A test (or examination) is a set of questions which yields an accepted set of "true" answers. Tests prepared by an examinations authority are usually called public examinations. Such tests are administered to a target group for whom the instrument is meant. Their preparation involves a panel of setters and moderators.

Teacher-made tests can be prepared either individually or by a group of EE teachers.

Preparation of a Test on EE Content

When preparing a test you should bear the following considerations in mind.

- content or course or theme/units covered
- objectives covered with the students
- process objectives/thinking skills that the items will test
- number of test items
- variety of test items
- time given to complete the test

Written tests are in most cases associated with end of term or monthly assessment, and emphasize mainly the knowledge aspects of learning. They are also associated with some form of grading, such as ranking, and decisions as to whether to promote a student to the next level of education or not. It is no wonder that some learners view them with awe and at times downright opposition. Negative attitudes of this kind can only be eliminated if you adopt a more imaginative approach to written tests by making a wider and more constructive use of data from them.

A common problem of writing tests is their monotony. Multiple choice and short answer questions often dominate written tests in primary schools. This monotony results from both lack of knowledge of alternatives, especially on the part of untrained teachers, and, at times, from sheer negligence by trained teachers. The alternative question formats that you may choose from include, for example:

1. objective tests,
2. short answer questions and
3. essay questions.

Objectives Tests

These are highly structured evaluation tools which can be varied in format as indicated below:

a) True-False (or Yes-No, Agree/Disagree)

Example: Make a cross (X) in the box that corresponds with your opinion on the statement below so as to show whether it is true or false.

Statement	**Opinion**	
	True	False
All desertification is caused by draught	☐	☐

b) *Alternative response*

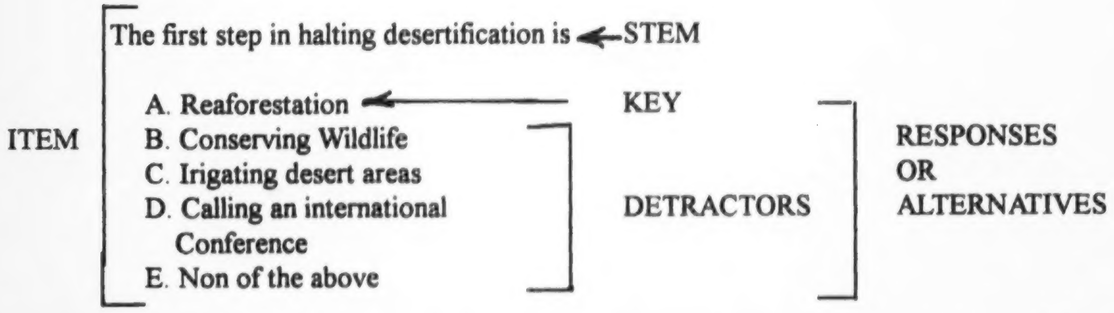
Example: Underline the right clause (or cross out the wrong alternative clause) so as to complete the statement below correctly:

The most hygienic way to dispose of domestic refuse is to:

(i) throw it in the vegetable garden.
(ii) bury it in a garbage pit.

c) Multiple choice

The following example explains the various terms associated with a multiple choice question.



The first step in halting desertification is

A. Reaforestation
B. Conserving Wildlife
C. Irigating desert areas
D. Calling an international Conference
E. Non of the above

The multiple choice format may be applied in several ways. It can, for example, be used for the interpretation of maps, charts, pictures, photographs, graphs, etc. besides its common use in testing for factual knowledge.

d) **Matching Items**
Example: Below are two lists A and B. Items in A are to be paired with those in B to show the cause - effect relationship.

LIST A	LIST B
a) Diarrhoeal diseases	(i) Devegetation
b) Diarrhoeal deaths	(ii) Bad sanitation
c) Desertification	(iii) Dehydration

Use this table to match correctly the items in A with those in B.

List A	a	b	c
List B			

Objective tests have their merits and demerits. However, if properly composed and administered, they are particularly suitable for the younger learners that is those in years 1 to 4 of their education, and in very crowded classes, say with over 30 children.

Application to learning situations

Some of the evaluation tools that a teacher uses to test for learners' acquisition of knowledge, skills, values and attitudes can be used by the learners themselves during information-gathering. For example, during the 3rd to 6th year of the primary school, children can be trained in the construction of simple true-false and multiple choice items. Further variations that we have examined above can be introduced during years 5 to 8 as the information gathering exercise becomes more sophisticated and application challenges are increased.

Table 8.H: Advantages and Disadvantages of Objective Tests

Advantages	Disadvantages
Preparation	
1. Enable wide coverage of objectives. This helps the reliability of the measurement	1. Time consuming
2. Questions can be matched to specific criteria for diagnostic testing	2. Considerable skill required to construct good questions
Measurement of knowledge objective	
3. Very efficient for measuring, recognition comprehension and application	3. Does not measure recalls, though this may be involved in selecting correct options
	4. Inefficient for measuring realization

Measurement of skills objectives	
4. Very efficient for measuring skills involved in interpreting data, analyzing data and evaluating evidence	5. Of limited value in measuring skills involved in identifying and clarifying issues and gathering and organizing data 6. Inefficient in measuring skills involved in generalizing problem solving, and making value judgements
Effects on student learning	
5. Encourage wide coverage of course content and development of wide range of skills understanding	7. Does not encourage organization and expression of ideas, originality, creativity and divergent thinking
Marking	
6. Quick and efficient 7. Objective 8. Highly reliable	8. Guessing can contribute to score
Reliability and validity of measurement	
9. Wide coverage of course helps reliability of measurement and permits high content validity to be achieved 10. Marker unreliability virtually eliminated	9. Achievement of reliability requires great care in construction 10. Some important objectives not measured

Short Answer Questions

These are a transition between the highly structured objective questions and the highly subjective essay type questions. As the name suggests, only short precise responses are required. These may vary from one line of, say, four to six words to a short paragraph of about fifty words. Their advantages and drawbacks are outlined in the table below.

Table 8.I: Advantages and disadvantages of short-answer questions

Advantages	Disadvantages
Preparation	
1. Enable good coverage	1. Time consuming
2. Questions can be matched to specific criteria for diagnostic testing	2. Difficult to construct good questions, especially involving higher level abilities

Advantages	Disadvantages
Measuring of knowledge objectives	
3. The most efficient method of measuring recall	3. Inefficient for measuring realization
4. Can be used to measure comprehensive application	4. Problems occur with measurement of comprehensive application
Measurement of skills objectives	
5. Moderately efficient measuring data-processing skills	5. Difficult to set skills questions without either making the answer obvious or leaving it open to a variety of interpretations
6. Most efficient method of measuring generalizing	
Effects on students learning	
7. Encourage detailed coverage of course content, development of expression skills	6. Does not encourage organization of ideas, originality, creativity, divergent thinking
Marking	
8. Semi-objective	7. Time consuming
9. Moderately reliable if care is taken in construction of questions	8. Problem of shadow areas between the acceptable and the unacceptable
10. Guessing unlikely to contribute significantly to score	
Reliability and validity of measurement of course content	
11. Wide coverage of the course helps reliability of measurement and permits high content validity to be achieved	9. Danger of triviality because of difficulty of constructing higher level questions
	10. Marker's unreliability becomes a problem unless great care is taken in construction

Application to Learning Situations

In learning how to construct a questionnaire, students must be exposed to the importance and use of short-answer questions in gathering information. As they are being evaluated using short answer questions, their attention should regularly be drawn to the use of this method in information gathering and the occasions when it has been used.

Essay Questions

These are considerably more demanding on the learner than the first two types of tests. They call for more thorough and longer answers. Therefore considerable elaboration of answers is required.

Essay questions are highly reliable tools for evaluating learning and can be varied so as to test for development of different levels of learning in the learners. The questions should be designed in such a way that their responses will indicate knowledge (memory), comprehension, application, analysis, synthesis and evaluation capabilities of the learner during and at the end of a course. This can be done by using variety in phrasing the questions.

When setting essay type questions you should recognize the benefits you can enjoy and the limitations you expose yourself to in making the choice. You should also recognize the generalization that essay question tests are more suitable to the more mature learners.

Table 8.J: Advantages and disadvantages of essay type of questions

Advantages	Disadvantages
Preparation 1. Quick and relatively straightforward to prepare	1. Poor coverage of course content and objectives; contributing to unreliability of of measurement 2. Difficult to match questions to specific criteria for diagnostic testing
Measurement of skills objectives 2. Best available techniques for measuring realization. Also measures application efficiently	3. Inefficient for measuring recognition, recall and comprehension
Measurement of skills objectives 3. Most efficiently used in measuring skills involved in identifying and clarifying issues, gathering and organizing data, problem solving and making value judgement	4. Inefficient in measuring skills involved in interpreting data, analyzing data and evaluation of evidence
Effects on learning 4. Encourages organization and expression of ideas, and glib originality, creativity, divergent thinking	5. Encourages facile student treatement of topics 6. Encourages rote memorization of course content

Marking	7. Time consuming 8. Subjective 9. Unreliable 10. Students can cover up deficiencies by use of rhetoric techniques
Reliability and validity of measurement 5. The only available technique for measuring some important objectives	11. Extremely difficult to obtain realibility in terms of question, student performance and marking

Sample Lesson: How to Evaluate

This lesson can be taught by tutors in teacher colleges. If you are not involved in teacher training you should still find it useful to read through and try out aspects of this sample lesson. The lesson is made up of three main activities, namely:

1. Preparation of evaluation instruments in class
2. Group work on the field of study
3. Follow-up activities back in class

Subject: Evaluation

Topic: Field study in a habitat around the school.

Resources

- The farm-bush area around the school
- Pupils' questionnaire
- Teacher checklist (of students' process of inquiry)

Objectives

By the end of the lesson, student teachers should be able to:-

- Identify the vegetation and animals in the area.
- Recognize the activities of the animals.
- Explain the extent to which the vegetation has been cleared.

Introduction

In the last lesson, we discussed some of the ways to evaluate various aspects of the EE curriculum, e.g. how to evaluate:

- New curriculum materials
- Teaching-learning processes

In this lesson we shall discuss techniques of evaluating students on a field study.

Development

Activity 1: Discussion

Discussion on the planning for the field study, i.e

- The site - neighborhood farm-bush of the college/school
- The instruments to use for evaluation during the process of enquiry on the field

Activity 2: Preparation of the questionnaire by students

Tutor supervises students to draft and edit students' questionnaire. This will include investigation of various aspects in the farm-bush area e.g

STUDENT QUESTIONNAIRE FOR FIELD STUDY

Class ....
Date ....
Location/Site ....

Topic: Study of farm-bush area around the college/school

- Name the type of vegetation ....
- Name the animals in the area ....
- Describe the activities/behaviours of the animals ....
- Name the common plants/fruit trees around ....
- What are the main uses of the named types of vegetation in the area? ....
- With the aid of a sketch outline map of the area, show the location of land use in the area........................ ....
- State which sections have had their vegetation cleared by human beings and animals and the extent to which this has been done...

The tutor(s) teacher(s) prepares a checklist to evaluate the teacher trainees' process of inquiry on the field.

Table 8.K: Tutor/Teacher checklist

CATEGORIES OF BEHAVIOUR.	GROUPS			
	A	B	C	D
Tutor gives direction to group				
Tutor asks questions				
Trainee(s) answers questions				
Group discusses				
Group asks questions				
Group answers questions				
Group takes notes and sketches				
Group collects objects/ materials				
Group asks tutor questions, etc				

Activity 3: Students and tutor/teacher on the field

Groups' work based on the students' questionnaire
Tutor's work based on the checklist at hand.

Follow-up to the field study

Activity 4: Each group puts its report together

Activity 5: Group reporting, followed by a whole class discussion and summary

Activity 6: Sketching and modelling of the study area

Conclusion:

The tutor/teacher and students discuss the findings; they itemize the main points and arrive at conclusions. Some of these may include the following:

1. Large sections of the farm-bush area have been cleared for:

   a) human settlement
   b) farming activities

2. The farm-bush supports only small animals, e.g squirrels and guinea pigs that feed on soft grass.

Evaluation of the Teacher

The teacher's self evaluation of the observations and coding in the checklist; self evaluation of the level of objectivity in coding and analysis of each group's activity:

- on the field and
- follow-up in class to arrive at the best group's performance and rank order of performance

Evaluation of the students:

Group evaluation of each member's contribution and why they:-

- did so much
- did fairly well or very little

The tutor/teacher gives judgement in the form of grades on the performance of each group after commenting on the strengths and correcting the weaknesses of each.

Review of the Lesson

The selection of topic and site for the field work. Adequate preparation was made:

- in demarcating the area by the tutor,
- through preparation of measuring instruments by:
  a) The tutor
  b) Students

Class Summary Report: The final outcome of the above outlined process should be a class summary report of the field study. This report can be used for further referencing as appropriate in future.

Unit 4: When to Evaluate

Objectives The students should be able to.

1. State when evaluation should be conducted,
2. Give reasons to justify the timing for such evaluation.
3. Explain what formative evaluation is.
4 Explain what is summative evaluation.

Basic General Observations on Timing

Effective evaluation must always be an ongoing process and should be sustained by the teacher. Nevertheless, a number of concrete observations can be made regarding the timing of evaluation activities. These are:

- Evaluation is very much a matter of the teacher's or school's discretion.
- Its timing depends on the nature of the evaluation.
- The frequency of evaluation activities is subject to the purpose of the evaluation.
- The frequency is also a function of available evaluation resources.

Since all these factors vary a great deal from one teaching/learning environment to another, it is difficult to give a clear-cut rule on the subject of timing evaluation activities. What we want to emphasize here is the need to be flexible and objective in deciding when, and of course how, to evaluate.

Invariably, evaluation can be conducted before, during or after an educational experience. The decision which the teacher takes as to when to conduct an evaluation is underpinned, to a considerable extent, by the purpose for which the evaluation is conducted.

Evaluation Before a Lesson Begins

A teacher may decide to conduct an evaluation before the students undertake a course of study. You can do this if you want to ascertain the knowledge, skills and values with which the students enter the learning process. For example, if you want to gauge the priority which students place on objectives of studying the environment you could provide them with a list of goals to rank. Below is an example of such a list:

Objectives for Studying the Environment

Which of the following objectives do you consider to be most important in studying the environment? Rank them in their order of importance, starting with 1 against the most important and 7 against the list important

a) To acquire knowledge about the components of the environment

b) To appreciate the fact that the various components of the environment interact with one another

c) To have a positive feeling about the environment

d) To ensure that people take good care of the environment

e) To know the things which pollute the environment

f) To take measures to prevent environmental pollution

g) To know how important the environment is to people

This exercise, apart from serving as an ice breaker (establishing rapport) can also provide a useful point of departure for deciding on what to begin the course with, as well as how to do so. The teacher may also elect to ascertain the attitude of the students towards a course on the environment upon which they are about to embark. This can be done by providing the students with a series of statements on which they should express their feelings or views. This exercise will be illustrated later on in the unit.

Many curriculum evaluators describe this as the evaluation to ascertain entry behaviour, i.e the knowledge, skills and attitudes which the students possess at the time of embarking on a teaching-learning encounter or a course of study.

Formative Evaluation

Evaluation can also be carried out during the teaching-learning process. If, for instance, you set learners the task of undertaking a project, you could go round to observe how the students are performing on the project. This evaluation will offer you the opportunity to find out whether students have difficulties or not. In particular, you will be in the position to identify students who are making progress without difficulties and those students who have problems . The evaluation, in this respect, is diagnostic and you use it to discuss the cause of the problems of some of the students. The discussion may ultimately lead to the elimination of the problems so that progress could be made. The cause of some of the problems during the observation could be related to the student's approach, the materials in use, lack of appropriate teacher guideline on the procedure for the performance of the task; or the fact that the task is difficult for the students to perform. You should then use the feedback to solve the student's problem immediately with them. You can also use the feedback to improve upon your own strategies.

Technically, the evaluation which is done either in a teaching-learning process or in the process of any educational encounter or in the process of the design of a programme of instruction is called **formative evaluation**. It is formative because this type of evaluation helps to form the learning process into the desired shape and direction, i.e. towards perfection. In ordinary classroom language, formative evaluation is called continuous assessment.

Summative evaluation

You may decide to conduct an evaluation after a unit or a series of units on a theme you have dealt with. This is what is known as **summative evaluation**. Related to classroom practice, this evaluation is conducted either at the end of a term semester or an academic year. It may also be conducted after completion of a project, a visit or a symposium. If the teacher intends to evaluate knowledge on, for instance, the project undertaken or the symposium attended she/he can use the following questions:

1. Describe how you went about your project.
2. How far did the symposium achieve its objectives?

If, on the other hand, you decide to investigate students' attitude towards a course of study on the environment, say over a semester, you could provide the students with a series of statements on which they have to express their feelings. The example below illustrates the point.

Below are some statements on the study of the environment. Place a tick in the appropriate box below indicating your stand in respect of each statement. The following codes have been used in the table:

SA= Strongly Agree; A= Agree; U= Uncertain; D= Disagree; SD= Strongly Disagree

STATEMENTS		RESPONSES				
		SA	A	U	D	SD
1.	The environment should be studied by every student.					
2.	A course on the environment should be optional.					
3.	Environmental studies should not be included in the curriculum.					
4.	Learning about the environment makes the students understand their surroundings better.					
5.	Studies on the environment make the student become careful in the use of their school, locality and country.					
6.	Studying about the environment is difficult.					
7.	Learning about the environment is a waste of time.					
8.	Environmental Education should be given more explicit attention in the curriculum.					

Since the decision on when to conduct an evaluation depends largely on the purpose, it may be useful to remind you of a few more purposes of evaluation. These include:-

1. Providing guidelines to students as to what is essential
2. Providing students with a target to aim at
3. Making students have a sense of achievement
4. Consolidating desired behaviour
5. Offering signals when students are going astray
6. Predicting performance and facilitating selection of students
7. Enabling students to make decisions about their future
8. Providing information for employers and parents

Evaluation

Evaluate the unit by asking students to do the exercises below:-

1. Do you think it is necessary to conduct an evaluation **before** the beginning of a course? Why?
2. Describe what is formative evaluation.
3. Describe the purposes of formative evaluation.
4. What is summative evaluation?

5. State the purposes of summative evaluation.
6. Design an instrument for summative evaluation. Explain when and how you would use that instrument.

Unit 4: Utilization of Evaluation Information

This unit mainly discusses the various groups and individuals who may need to use evaluation information and how they can use it.

Objectives

By the end of this unit, you should be able to:-

1. List some of the groups, organizations and departments who use evaluation information
2. Explain how each of the named groups, organizations and departments uses the information
3. Employ appropriate techniques in teaching about using evaluation information
4. State the importance of using evaluation data
5. Analyse evaluation data
6. Prepare an evaluation report
7. Use evaluation information to make appropriate decisions.

Resources

- Self-evaluation forms
- College assessment forms
- External evaluation forms
- Report forms
- School leaving certificates
- Employment application letters (written by students for simulation game)

Activity: Group Discussion

1. Earlier in this chapter we dealt with the reasons for evaluation. With that background, try now to answer the following two questions:

   a) Who will use information from a given evaluation?
   b) How will they use it?

2. Give your students enough time to think about, and answer each of the questions. It may be useful to allow time for group discussions. Each group should record its answers and compare them with those of other groups.

3. The answer to the first question on who will use evaluation information may include the following points:
   a) Learners
   b) Teachers
   c) Parentsg
   d) Employers
   e) Curriculum developers
   f) Publishers
   g) Examining bodies
   h) etc

To this list, you may add any other interested parties which were mentioned in your discussion.

4. The next question is how do the above groups use evaluation information? In order to get fuller responses to this concern, it might be advisable to divide the class into groups and assign a group or two groups of users to a discussion group.

The various discussions you have had in the above activity have set a stage for us to look in more details at the various users of evaluation information. This will be our concern in the remaining section of this unit.

Just a Reminder!

Again, the main users of educational evaluation information include:

1. **The learners themselves**
2. **Teachers**
3. **Parents**
4. **Employers**
5. **Curriculum developers**
6. **Publishers**
7. **Examining bodies**

Learners

Learners are interested to know how they compare with their peers in the same class, same stream, other schools, region and country. This comparison acts as an indicator of ones' performance gauged against their counterparts. Using this information, learners may be able to predict their performance in national examinations, for example. Such information may also be useful for deciding improvement generally or for specific subjects. To this end, the student may want to give more study time for those subjects in which they performed poorly.

On the other hand, a student may get some feedback on the subject in which they are particularly good. On the basis of this information, learners can choose what subjects they are good in and related careers. These students may also want to drop certain subjects which they find particularly difficult, if such an option exists.

Teachers

Earlier on, we discussed what to evaluate. During that session, one area which was suggested to be one of the concerns of evaluation is the process of teaching. This process can be evaluated in three ways. These are:

- Self-evaluation
- Evaluation by a personal tutor or others from your college
- Evaluation by an external assessor

Self evaluation is carried out by the teacher after giving a lesson. This is the process during which the teacher asks himself or herself questions such as:

- What were the lesson objectives?
- Were these objectives achieved? To what degree were they achieved?

- Were these objectives achieved? To what degree were they achieved?
- Were the learning opportunities/activities geared to achieving those objectives?
- Were the method(s) and techniques used in teaching the most appropriate? What other alternative methods or techniques could have been used?
- Were there teaching aids? Were they well prepared? Were they relevant to the content? Were they appropriately used? Did they enhance learning?

The main goal of this retrospection is for the teacher to determine the strong and weaker aspects of her or his instruction, and to use them to enhance the quality and impact of her/his subsequent teaching.

Evaluation by a personal tutor is normally for two reasons. The first is formative whereby, a practicing teacher will be left with comments written by the tutor during a lesson observation. These comments should be read seriously as they are meant to improve the teacher-trainee. It may also be useful to discuss such comments with the tutor if the expected improvements are not understood. The second use of evaluation information by tutors is for grading their trainees.

External examiners on the other hand gauge the outcome or the end product of the training, the experience gained through teaching practice, self evaluation and the formative evaluation carried out by the tutors. This is largely for giving a grade to the student teacher. This grading may very well determine at what level the teacher may be employed. It may also result in failure or referral on the part of the trainee. Information by external examiners can also be used to enhance the quality of the programme of a department, faculty or college.

Parents

Parents are always interested in the performance of their children and expect a report on this termly or annually. Such reports do not only help the parents to know how their child is performing but also how they can rate the school in terms of its performance in national examinations, for example. Parents will always try to put their children in schools which are deemed to be performing well.

At this point, students should be asked to give their ideas on other ways in which parents can use evaluation information. The teacher should make a chalkboard summary of these.

Were the following mentioned by the students?

a) Parents will be able to help their children in the subjects they are not very good at.

b) Parents will be able to help their children in making career choices.

c) Parents' associations may make some demands or suggestions to education authorities using such information. Let pupils suggest such demands and suggestions.

Employers

Activity: Role playing

1. Ask students, in groups, to role play a panel of interviewers for a company which is in need

of new trainees. They should elect a chair for the proper conduct of the interview. There should also be a secretary to take notes of questions asked and answers received.

2. Other students should play the role of job seekers. They should bring in copies of their original applications and their testimonials for the positions. Each candidate for the position should appear before the panel individually.

3. The rest of the class must remain silent during the interviews and only act as observers. They should take notes.

4. Make a summary of the points raised by the question- answer session.

5. Some of the main considerations that are expected to emerge during the discussion should include the following:

   a) qualifications
   b) their performance in school exams
   c) teachers report e.g. school leaving certificates
   d) the candidates' behaviour, conduct in school extra-curricular achievements
   e) why such things should interest employers
   f) candidates for referees and their importance
   g) legal/criminal records and their importance

Publishers

Let the students mention some books they have read.

a) Do the students know the names of the authors, year of publication and the publisher? Why is such information necessary?

b) How do pupils decide that a book is good for a certain subject? What do they look for in a book?

c) Is the information suggested in (b) above of any relevance to the publisher. In what way?

Examining Bodies

Let the students answer the following questions.

a) Do students of your college do an external examination? If so, what is the examining body responsible for that examination called?

b) Is there a central examinations body in your country/state? What is its name? What are its functions apart from conducting the examinations?

c) How does the examining body use evaluation information from national examinations?

RECAPITULATION

1. **List four groups of people who would be interested in evaluation information.**

2. **How does evaluation information help**

    a) **the teacher?**
    b) **the parent?**
    c) **the curriculum developer?**

3. **List four pieces of information of a candidate's past, that a prospective employer would want to know.**

4. **Why would the employer want each of the pieces of information just listed above?**

5. **Supposing you are a publisher who wants to know how well a book from your company is doing in the market. Make a list of questions which you would like to ask teachers about the book. Write a reason for asking each of the listed questions.**

The Importance of Analyzing Evaluation Data

We collect data in their basic form; in such a state we refer to them as *raw data*. In order to serve any useful purpose, these data must be analysed. Such analysis helps us to get some meaning out of the data. Analyzing evaluation data therefore is important because it enables us to determine the following:

- achievements of educational goals and objectives;
- the worth of these goals and objectives, and.
- unanticipated outcomes and their relative values.

Together, these modes of analysis assist educators to judge the worth of their programme.

Although the techniques presented in this chapter will help you make these decisions with increased objectivity, you will not be able to eliminate subjectivity altogether. Indeed, you should not, since intuition has, in more than one instance, kept programmes alive which eventually were proved effective in unforeseen ways. And, in fact, if you have followed these guidelines this far in evaluating your programme, you will have accumulated a fair amount of subjective data which may reinforce your own intuitions.

The process of analyzing evaluation data usually starts with summarizing them in a more or less descriptive form. Some of the formats of doing this include:

- measures of central tendency: mean, mode, median
- measures of variation or spread (dispersion): percentiles, quartiles, the range and, standard deviation
- predictive indices: probability
- measures of relationships: correlation indices

It may not be possible to make a comprehensive report each time an evaluation activity is conducted. Selection, grouping, or some form of averaging may be more practical ways of reporting on day to day evaluation. But all major evaluation projects/programmes (e.g. terminal and annual) should lead to evaluation reports. The main contents of such reports should include the following:

- Purpose
- Abstract
- Programme rationale, goals and objectives
- Programme description
- Programme evaluation process
- Programme results
- Conclusions and
- Recommendations

Evaluation Follow-up: Improving the Instruction Programme

Ultimately the purpose of evaluation is to improve the programme so that it will have an enhanced impact on students' learning, society at large, and the quality of our environment. Perhaps the first step in following up on an evaluation is to examine the recommendations of the final report in the light of the programme's rationale, goals and objectives. One of the more immediate uses of evaluation results is to correct deficiencies in understanding, thinking, and interpretive skills revealed during the assessment. In this sense the evaluation may serve as a tool of diagnosis and prescription.

Remember that you, the teacher, have control over the instructional programme and are responsible for instituting the changes necessitated by an evaluation. Guard against your biases. Such changes may make it necessary for you to abandon a favourite method, learning activity, or instructional act. But be honest with yourself and remember that the most important goal is to improve the efficiency and effectiveness of your programme.

In your follow-up efforts to an evaluation consider the following concerns:

1. Set priorities. Decide which recommendations to implement first, second, third and so on.

2. Establish a time-scale- a schedule for implementing the recommendations.

3. Identify the major opportunities and constraints related to the implementation of the recommendations. These may include, for example, the following:

    - time
    - money
    - human resources
    - information
    - material and equipment

4. Monitor the implementation process.

References

Worthen, B.R. and Sanders, J.R. (1987). Education Evaluation. White Plains, N.Y., U.S.A.; Longman.

Piper, K. (1976). Evaluation in the Social Sciences. Canberra Australia; Australia Government Publishing Service (pg. 58).

Education Development Center (1970). Man: A Course Study, Evaluation Strategies; Washington D.C.; Curriculum Development Associates.

CHAPTER NINE

NATURAL RESOURCES.

Introduction

In this chapter we shall identify and learn about natural resources. We shall discuss problems that result from use of these resources and suggest possible solutions to the problems. We shall also review management practices that relate to the use of natural resources.

It is important that we know how to manage resources wisely because they provide for our needs and those of future generations. In short, our current and future development depends on how we use and manage these resources.

Objectives

After studying this chapter, you should be able to:

1. Define the term **natural resource**.
2. Identify and give examples of the different resources we have in the environment.
3. Describe the use to which we put the resources.
4. Identify the problems that people create by using natural resources carelessly.
5. Identify the problems associated with natural resources.
6. Gather, interpret and analyse data relating to environmental issues.
7. Apply principles of resource management by carrying out action-oriented conservation activities.
8. Prepare lessons on natural resources.
9. Assess the knowledge, skills, values and attitudes that students have acquired about resources.

Classifying Resources

Activity: *Meaning of the Term Resource*

1. Ask the students to walk around the school compound and observe, identify and list the materials that they come across. Back in class the students should hold a discussion on the various uses of the materials they have listed. The students should then define a **resource** in terms of something that can be used or has the potential for use. In other words a resource is that object which people take to be of value in meeting their needs and wants. Some of the items that the students have listed can be used as examples of resources.
2. Guide the students to draw a diagram showing the various things that are found in the school compound.

Using the diagram, the students identify the items that are in the environment and list them. The teacher then guides the students to define the things that are not made by people as resources that are natural. These may be in the form of matter or energy. Examples may include soil, water, etc.

Some of these materials are not being actively used. Such materials are known as having potential use only.

Types of Natural Resources

There are a variety of ways in which natural resources can be divided into broad categories. The mode suggested below is only one of them.

Renewable Resources

These are resources that continue to replace themselves and are likely to be there if we balance the rate at which we use them against their rate of growth or reproduction.

Non-Renewable Resources

These are resources which are present in the environment in finite or limited quantities while the demand for them is infinite or unlimited. The rate at which they are formed is too slow to compensate for the amount used. Their quantities decrease with time.

Inexhaustible resources

These are the ones whose amount does not decrease with time. We cannot see a time when they will not be there.

Recyclable Resources

These are the resources that are not destroyed by use and can therefore be recycled and re-used.

Now use these definitions in guiding the students to classify natural resources that they have come across. Using these guidelines, the students should draw and complete the table that follows, and give examples of the resources they have listed.

RENEWABLE RESOURCES	NON-RENEWABLE RESOURCES	INEXHAUSTIBLE RESOURCES	RECYCLABLE RESOURCES

Resources are closely related to one another. To demonstrate this let us examine the interrelationship of four categories of resources, namely, people, animals, plants, and inorganic resources. Figure 9.1 illustrates their interrelations.

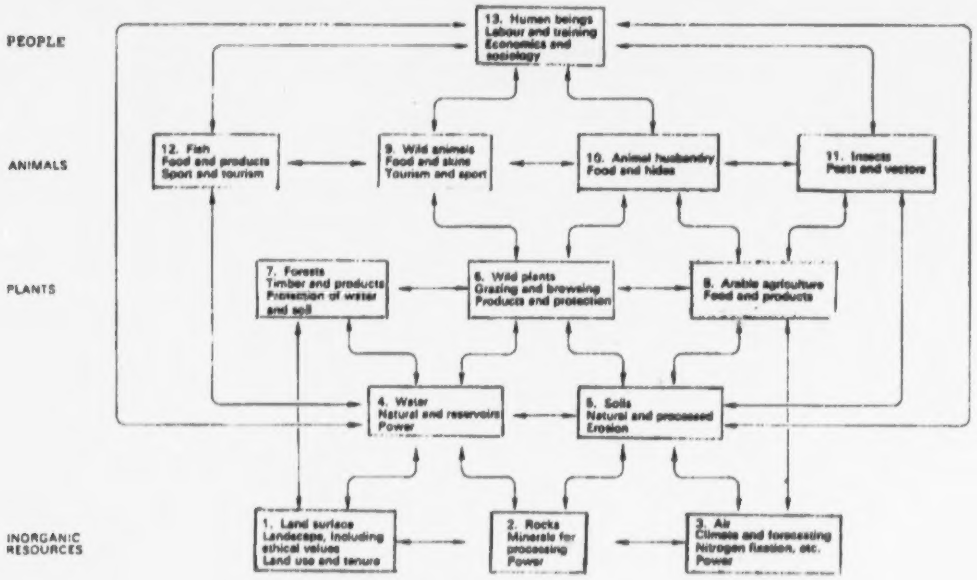

PEOPLE
ANIMALS
PLANTS
INORGANIC RESOURCES
13. Human beings
Labour and training
Economics and sociology
12. Fish
Food and products
Sport and tourism
9. Wild animals
Food and skins
Tourism and sport
10. Animal husbandry
Food and hides
11. Insects
Pests and vectors
7. Forests
Timber and products
Protection of water and soil
6. Wild plants
Grazing and browsing
Products and protection
8. Arable agriculture
Food and products
4. Water
Natural and reservoirs
Power
5. Soils
Natural and processed
Erosion
1. Land surface
Landscape, including ethical values
Land use and tenure
2. Rocks
Minerals for processing
Power
3. Air
Climate and forecasting
Nitrogen fixation, etc.
Power

Fig. 9.1 The interrelations of natural resources

Water as a Natural Resource

Occurrence of Water

Water can be found either in solid (ice), liquid or gas (vapour) form. We find water not only in the environment around us, but also in all living organisms on earth. For example, in human beings water constitutes 80% of the body. In plants it constitutes between 60 and 75%. Other animals and plants are constituted of varying amounts of water. This means that there can be no life on earth without water.

Water occurs in the atmosphere, on the surface of the earth and underground (Figure 9.2). It is always changing these positions as the following study of the water cycle shows.

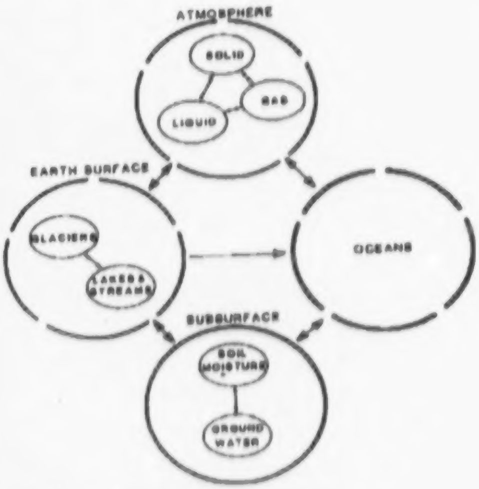

ATMOSPHERE
SOLID
GAS
LIQUID
EARTH SURFACE
GLACIERS
LAKES & STREAMS
OCEANS
SUBSURFACE
SOIL MOISTURE
GROUND WATER

Fig.9.2: Occurance of water

Activity: *The Water Cycle*

Draw the diagram on the chalkboard/card paper to illustrate the different states of water. The students should study the diagram and describe the changing of the states of water. Students copy and label the diagram.

Draw the water cycle on the chalkboard/card/paper for students to copy.

Guide the students to copy the diagram and to explain the importance of the changes of the states of water in the water cycle.

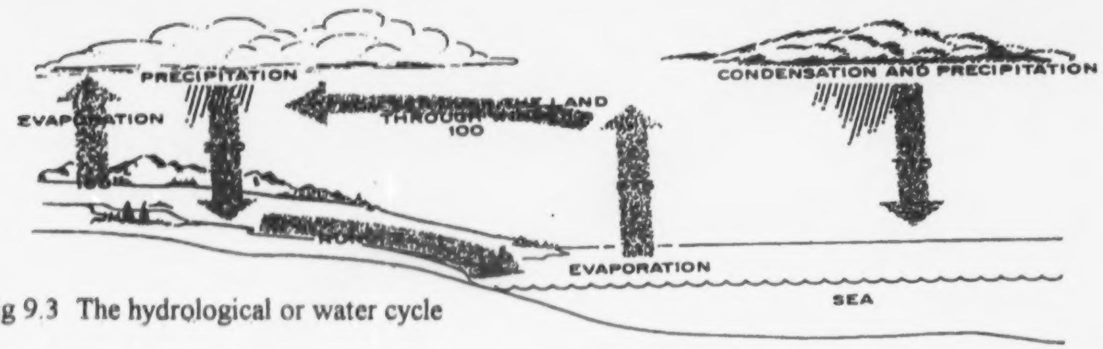

PRECIPITATION
EVAPORATION
LAND
THROUGH
100
CONDENSATION AND PRECIPITATION
EVAPORATION
SEA

Fig 9.3 The hydrological or water cycle

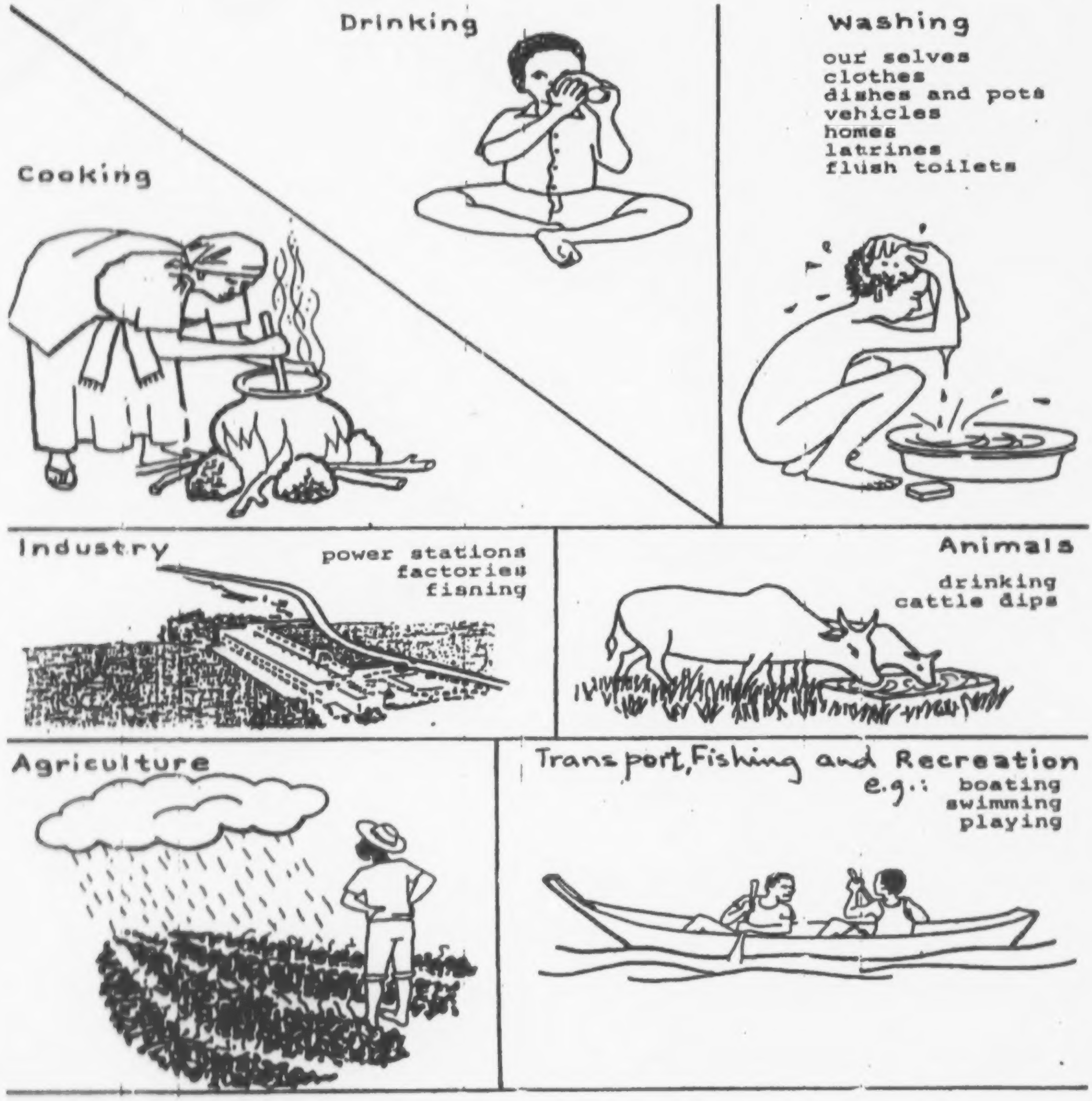

Drinking
Washing
our selves
clothes
dishes and pots
vehicles
homes
latrines
flush toilets
Cooking
Industry
power stations
factories
fisning
Animals
drinking
cattle dips
Agriculture
Transport, Fishing and Recreation
e.g.:
boating
swimming
playing

Fig. 9.4: Selected uses of water

Activity: *Impurities in water*

Water is not pure. It contains many things such as salts, solids and gases. Water dissolves minerals from the soil and absorbs gases from the air. It also picks up particles when it flows on the ground.

Ask the students to bring water from different sources from their locality, such as well, river, pond, and so on. Let them observe and compare the water and describe what they see in it.

Now guide the students to conduct a simple experiment involving filtration to show the impurities water contains. The presence of these impurities means that the water is polluted.

Let students boil the filtered sample of water and record what they observe after the water has evaporated. The substances that remain behind are called impurities or sediment.

Uses of water

As already mentioned, water is vital to all living things on earth. To what use do human beings put water? In response to this question you will find the information in fig. 9.4 helpful for suggestions.

The water uses suggested above can be grouped into three broad categories. They are industrial, socio-cultural and natural uses. For further clarification see the table below.

Industrial use	Socio-cultural use	Natural use
Generating hydro-electric power	Water is used in religious activites	Water is a habitat for some living things.

Activity: *Availability of water*

Ask students to look at a world map. Ask them to observe:

- The world's oceans/seas
- Lakes and rivers
- Polar caps.

They draw a pie chart showing the proportions of water and where they exist; 94% Oceans, 2% Polar Ice/Glaciers, 4% Total Ground water.

Misuse of water will lead to undesirable consequences for development. There is need to ensure continued availability of supply of water in order for human, plant, animal and other species can continue existing. This need for water calls for a number of measures to be taken to guarantee its continuous supply. Among such measures are the following:

•building of large reservoirs (dams) to control water runoff

- water transfer from areas where it is abundant to areas it is in short supply
- use of desalinated sea water

Students, working in groups, should now conduct a survey of the sources of water in their communities. Students suggest what policy guidelines can be instituted to harness the existing and potential water resources in the community. Learners critically look at the existing control uses that are likely to relate to water use and assess whether such uses will guarantee availability of water for sustainable development. They then compile group reports and present them to the rest of the class.

Protecting Water From Pollutants

The state of fresh water resources is a matter of grave concern in many countries. Humans, the greatest users of water, are also largely responsible for its pollution. We contaminate, pollute or make water unsafe in many ways. The table below shows some of these ways through which water can be contaminated. Indicated also are the measures that individuals and groups can take to solve the problem of water pollution.

Activity: Aspects of water pollution

Copy the table below on the chalkboard or flip chart. Students copy the diagram and fill appropriate information into respective columns from their locality and through research reading.

Causes of water pollution	Effects	Suggested solutions
Industrial waste	....	....

The learners visit a pond, well, or river that is contaminated. If none is nearby, photographs cut from magazines would be useful. Students identify the pollutants in the water and the sources of such pollutants. They write a report on the problem of water contamination and suggest action oriented solutions to the problem. This may involve students being assigned tasks to clear up the areas around a well or a protection spring. Students make posters to make people aware of the dangers of drinking contaminated water and spell out what can be done to make water safe for drinking. They display their posters.

Encourage learners to write letters to editors of newspapers and magazines to express their feelings about the state of water as a resource. They should highlight why they think people should pay particular attention to how they use water and how to make it available for human and animal consumption. These letters should become part of the bulletin board display to enable students to share ideas.

Problems Related To Water Resources

Water related problems mainly arise from the way we use it. However, sometimes forces of nature may also cause problems like drought and floods. In Africa the leading problems related to water are summarized in tables 9.A to 9.C and categorized as follows:

MAJOR PROBLEMS RELATED TO WATER AS A RESOURCE

a) **Availability**: The quantity available is lower than the amount required by the population, its livestock and the wildlife.

b) **Contamination**: The quality is of low standard due to interferences by the human population.

c) **Diseases**: As a result of the above problems some ailments befall the human population. (See also tables 9.A, 9.B and 9.C.

Fig 9.5: Draught; a water shortage problem

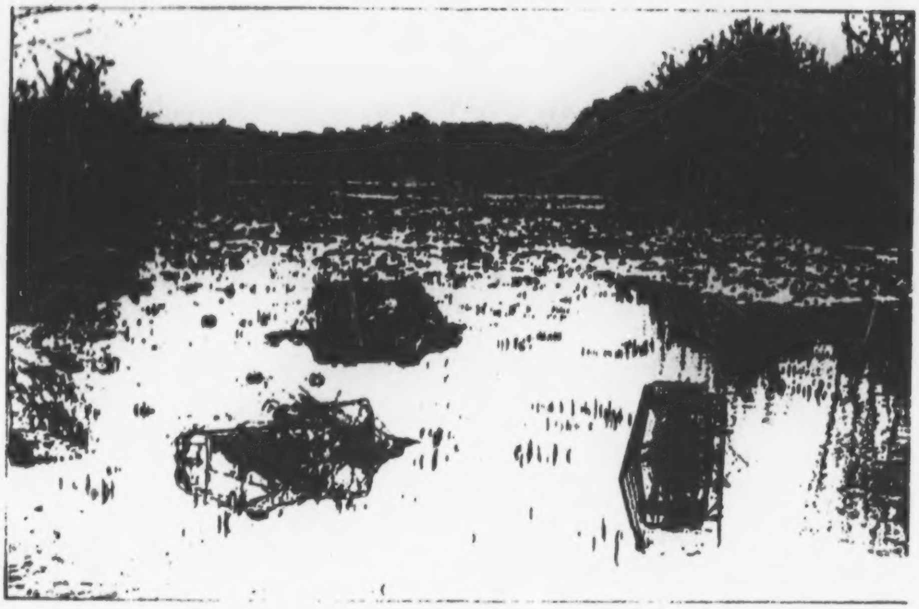


Fig.9.6: Pollution of wetlands; a contamination problem

Land Resources

Land Use and Its Problems

Land is an important resource because without it no development of any kind can take place. It is on land that we grow crops, rear animals, build shelter and construct forms of infrastructure. From the land we obtain minerals that we use to meet our needs and wants. In this section we shall treat soil as an important aspect of land resources.

Unfortunately, land resources are often misused. This abuse of land gives rise to a variety of serious problems. Some of these problems are listed in tables 9.D and 9.E

Activity: *Land Use Problems*

1. In groups, students begin by surveying land use activities in the community around the school. They should set out with outlines with headings identical with those in tables 9.D and 9.E
2. Groups visit places where land is being used. They observe and record what use the land is put to. They also record any problems they identify to be related to land use.
3. In class, groups discuss the problems they have identified; and they use the inquiry process to arrive at possible solutions to the problems. Students should, where possible, apply solutions to the problems.

Table 9.A: The Problem of Water Availability

Description	Causes	Effects	Suggested Solutions
Water is not found in adequate quantities where it is needed and when it is needed	1. Aridity due to dry weather conditions; 2. Poor water management, and 3. Devegetation reducing the amount of rainfall and ground water.	1. Many man hours are wasted in search of water; 2. Drinking and cooking water is not enough, and 3. Improper sanitation especially in urban areas.	1. Plant trees appropriate for the area and look after them; 2. Rehabilitate water catchment areas; 3. Install low cost water pumps in settled areas; 4. Learn to conserve water at the personal levels, for example, turn off the pipe even when there is no water running at the moment; 5. Re-use water; 6. Collect as much rain water as you can, for example, from roofs into containers, and 7. Control the demand by controlling the rate of population increase.

Table 9.B: The Problem of Water Contamination

Description	Causes	Effects	Suggested Solutions
1. Addition of substances that make water unfit for its intended use, and human consumption.	**Surface water contaminated by:** 1. Humans: urine and faeces, washing, clothes, bathing and swimming, disposal of rubbish; 2. Animals: grazing, urine and faeces, and 3. Industry: Polluting with rubbish and chemicals. **Ground water contaminated by humans through:** 4.Seepage from latrines installed too closely above water sources; 5.Children playing on pipes, clogging them or causing cracks to walls; 6.Clogging drainage pits and causing water to stagnate. 7. Throwing rubbish into water tanks, and 8. Drawing water with unsafe containers. 9. Allowing motor oil to seep into the ground.	**Quality of water is affected causing** 1. Ill health; 2. Water smells, and 3. Water looks dirty. 4. **Availability of water for various** uses especially for domestic use is reduced. 5. Make clean water dirty.	1. Fencing out animals from water collecting points; 2. Cleaning and sweeping the area; 3. Making proper drainage for both rain and waste water; 4. Installing a pump; 5. Building latrines downhill; 6. Using latrines and 7. Burying urine and faeces; **If latrines are not available:** 8. Disposing of rubbish in a pit away from water, and 9. Joining in water conservation activities in your community; **Storing water safely by:** 10.Washing hands before handling water containers; 11.Cleaning water containers, and 12.Covering water that is stored. 13.Letting it settle before drinking 14.Filtering it, and 15.Boiling it to kill germs. Take water from the cleanest place.

Table 9.C: The Problem of Water Diseases

Descriptions	Causes	Effects	Suggested Solutions
1. Cholera, diarrhoea, bilharzia, guinea worm, hepatitis, polio, typhoid, worms.	1. Drinking dirty water;	1. Ill health, death, lowered productivity;	1.Boil all drinking water;
2. Conductivitis, diarrhoea, eczema, impetigo, lice, ringworms, scabies, trachoma, and	2. Not having enough water to keep clean, and	2. As above and	2. Wash your body regularly;
3. Bilharzia, ear, eye, nose infection, swimmers' itch.	3. Bathing in dirty water.	3. As above.	3. Use pit latrine or bury your urine and faeces;
			4. Avoid playing in ponds, and rivers, and
			5. When infected seek treatment immediately .

Fig. 9.7: Surveying places where land is being used

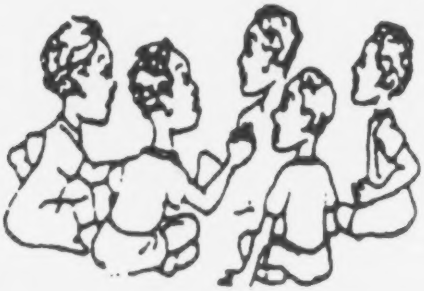


Fig. 9.8: Discussing the findings of the survey

Forest Resources

Activity: *Trees as a Resource*

1. Lead the class to revisit the definitions of the terms **resource** and **natural resource**.

2. Ask the students to work in groups and list the uses to which trees (wood) have been put in

   a) the classroom
   b) the school
   c) the surrounding community

3. Let the entire class discuss the lists and construct on the chalkboard a table with a heading "Local Uses of Trees" and three columns headed "In Our Classroom", "In Our School", and "In Our Community".

The Value of Forests

In many African countries rapid population growth is causing serious land shortages. As a result, people are clearing the forests to create room for cultivation and settlement. The fate of the Mabira Forest located in Mukono District along the Kampala-Jinja Road in Uganda illustrates the dilemma

Table 9.D: Problem Related to Land

USES	Problems with utilization	Possible solutions
1. Agricultural land	• Poor farming methods leading to erosion and desertification • Inappropriate application of too much fertilizers which make land too alkaline or acidic for plant and animal life • Application of pesticides that pollute the land	• Use of appropriate farming methods and technology Planting trees as wind breaks adoption of appropriate soil conservation measures such as terracing and vegetation cover • Appropriate chemical treatment of the soil to adjust its acidity or alkalinity • Use of safer pesticides and/or biological control methods
2 Rangeland	• Overgrazing resulting from overstocking • Burning of the veld or vegetation • Clearing vegetation for building, fencing for farming • Over fencing leading to interference with migration patterns of wild game	• Maintaining the animals at the carrying capacity of the land and adoption of proper grazing methods • Controlled burning of vegetation in rangelands • Utilization of alternative building and fencing materials • Fencing rangeland has to be well researched to minimize interference with the migration of wild game
3 Settlement	• Clearing areas of natural vegetation, for humans • Alteration of atmospheric gaseous balances	• Afforestation programmes to compensate for loss of vegetation cover
4 Quarrying and Mining	• Loss of soil, leaving behind wasteland • Leaving behind habitats for disease vectors such as mosquitoes, snails	• Re-habilitation or reclamation of wastelands

Table 9.E: The Problem of Accelerated Soil Erosion

Description	Causes	Effects	Possible Solutions
The top soil is exposed, loosened and then rapidly carried away by mobile agents, especially rain run-off and wind. Thus land is made infertile and less capable of supporting plant, animal and human life.	Improper agricultural practices such as: (i) Overcropping (ii) Overgrazing (iii) Devegetation (iv) Collection of organic matters like maize stalks for fuel and (v) Cultivating down slopes	a) Removal of top soil rich in humus b) Depletion of plants nutrients c) Reduction of soil depth d) Deterioration of soil structure e) Loss of cultivatable land due to gully erosion f) Desertification g) Accumulation of silt in dams, thus reducing the life span of dams and interfering with the hydroelectric power (HEP) production h) Loss of continental shelf due to silt being deposited in the sea i) Destruction of marine ecosystems like the coral reef ecosystem of the east coast of Africa j) Loss of humus and destruction of soil structure	a) Adoption of soil conservation measures such as: (i) Crop rotation (ii) Strip cropping (iii) Contour ploughing (iv) Terracing sloping areas (v) Use mulching (vi) Re-introduction of bush farrow system b) Planting and taking care of trees in: (i) Afforestation and re-afforestation programme (ii) Agroforestry (iii) Woodlots c) Application of animal manure and compost d) Regulating the demand of food, land and forest products by managing population growth e) Promoting environmental awareness in schools

caused by the competition between forestry and agriculture. The government has expelled all squatters, plantation owners and charcoal burners from the forest in order to protect it. This measure subsequently led to a lively debate in the local news papers.

The two extreme positions taken on the issue can be seen in the exchange of views which follows below:

EXPLOITATION AND CONSERVATION OF FORESTS

a) Forests occupy fertile land. They should be cleared to give way to crops, export crops and settlement.

b) Forest are an important resource which must be conserved and expanded.

The two letters reproduced here appeared in a Kampala English language daily newspaper. They represent the two opposing views just expressed in the two statements above. After reading them, the students should undertake the activity that follows on *Forests and Sustainable Development.*

LETTER 1

Dear Editor,

I am writing to you to register my surprise at and total disapproval of the way people are being kept out of forests. I am particularly against the current campaign to evict squatter peasants in the Mabira forest Reserve of Mukono District.

It is well known that agriculture is the backbone of our country's economy. We as planners should therefore remove all the obstacles which limit the expansion of agricultural land.

In Mukono District, soils are very fertile and rainfall is high. This is the reason why both plantation and peasant agriculture are very successful in our district.

Most unfortunately, a lot of good arable land is still under forests. Some of them, like the Mabira forest, are large and cover thousands of hectares. This is at a time when we need more food and export crops.

I suggest, therefore, that forests like Mabira should be exploited fully with a view to clearing them to give way to settlements and farms. Such an exploitation will bring the following benefits:

a) Timber supplies will increase for export and domestic markets.

b) More charcoal and firewood will be available to the people.

c) Pests, like tse-tse-flies which are harboured in forests will be easily eradicated.

d) More farmland and room for settlement will be made available.

e) Food supplies will increase.

f) Export crop production will also increase and improve the country's foreign exchange earnings.

g) More people will get jobs on new plantations and smallholder farms.

h) Agriculture processing and timber industries will be encouraged by the availability of raw materials.

For these reasons, forests should be vigorously exploited and cleared to make way for farming and faster development.

P. R. Kato,
District Agricultural Officer,
Mukono District.

LETTER 2

Dear Editor,

I believe very strongly that this country should take urgent measures to conserve its forests, because they are an important blessing.

Let me first of all outline their environmental value to the country.

a) They maintain and improve climatic conditions of the country.

b) They conserve and regulate water supplies by protecting the water table.

c) They protect soils from erosion, excessive evaporation and leaching.

d) They improve the quality of the air we breathe by adding oxygen to it and removing carbon-dioxide during photosynthesis.

e) They are above all, part of our ecosystems.

We must note that all these benefits do prevent desertification and pollution. This way, both land and health are protected. In addition, forests are of high commercial value and have the following benefits for the country:

f) They are a source of timber.

g) Carefully used, they ensure a continued supply of woodfuel and charcoal.

h) They also provide a high potential for wood-allied industries such as the manufacture of woodpulp, paper, newsprint, cardboard and other products that are at present imported by this country.

In addition to these benefits, most plant nutrients in our equatorial type climate are stored in forests.

When we clear or burn forests, we concentrate these nutrients into the soil where they are quickly lost due to erosion and leaching of the unprotected soils.

Besides these benefits, statistics show that the demand for forest products is on the increase. By the year 2000, Uganda will need 650,000 to 820,000 cubic metres (cu.m) of sawn and plywood timber, 1.4 to 1.6 million cu.m of poles, 50 million cubic metres of firewood and 30,480 tonnes of pulp and paper. With the present forest cover we shall not be able to satisfy this demand.

Inspite of the many benefits of our forests and the enormous expected demand for their products in future, in fact our forests are rapidly being reduced. Note also that since 1900 about 75% of forest cover was lost in only 60 years. At this rate of destruction, by the year 2000, Uganda will not have enough forests to satisfy even 10% of domestic demand. This will, of course, necessitate costly imports of wood-allied products.

In view of this possible future situation, we should not only conserve our present forests, but we should also try to expand them through afforestation programmes. This way we shall ensure protection of our environment and availability of forests for future utilization

J.M. Babirye,
District Forest Officer,
Mukono District.

Activity: *Forests and Sustainable Development*

1. Let your students read the two letters to the editor individually.

2. Working in groups of 6-10 students, the class should then answer the following questions.

a) What did you consider to be the strongest arguments for the exploitation of forests?

b) What are the strong arguments for the preservation of forests?

c) Using the arguments presented by the two officers, if you were the District Planning Officer, what action would you take on forests, and why?

Note: It will be very useful to refer to the section on devegetation as an environmental problem in chapter four.

Wildlife Resources

Activity: *The Uses of Animals*

1. Ask the students to list uses of animals in both homes and the community in general. Some likely answers that you should expect or even lead students to, include the following:

   a) Leather and skin (for varied uses)
   b) Meat, food, milk, etc
   c) Ploughing

d) Pets
e) Security (dogs)
f) Manure
g) Transport

2. Lead the class to revisit the term **resource** and help them to relate it to animals.

Animals As a Resource

Most uses of animals that students will have listed are likely to be related to domestic ones. However, all animals, domestic or wild, have environmental value. They are important to food chains and the sustenance of ecosystems; they maintain the balance of nature by feeding on vegetation and on one another, thus controlling populations. Animals are therefore an important part of our environmental heritage. For these reasons, they must be conserved as a resource. Unfortunately, when people fail to realize this, problems arise from the use of animal resources, especially wildlife.

The term wildlife refers to all those animals that are not domesticated and the natural environment in which they live (habitat). They both form an important part of the natural environment. Animals live in harmony with the other natural resources, like vegetation and water. They maintain a balance among themselves thus preserving the genetic resource.

An abundant and variety of wildlife not seen in other areas of similar size in the world exists in Africa. In Tanzania alone, for example, there are around 290 different species of land mammals, while over 800 bird species are known to breed in Kenya. The diversity of ecosystems found in Africa, ranging from desert to rainforest, might be one of the explanations or factors accountable for this abundance and great variety of wildlife in the region.

Wildlife Conservation and Management

Most national conservation strategies relating to wildlife in the region are based on the **World Conservation Strategy** initiated in 1980. Its three major objectives are:-

- To ensure sustainable utilization of species and ecosystems
- To maintain essential ecological processes and life-support systems
- To preserve genetic diversity

In Eastern and Southern Africa, several steps have been taken by governments to conserve or even increase wildlife. Some are listed below:

- Declaring protected areas, such as parks, reserves and sanctuaries
- Banning uncontrolled hunting of wild animals and trying to stop illegal poaching
- Banning all trade in game trophies like ivory, rhino horn and hides
- Educating the public on the intrinsic and economic value of wildlife
- Launching campaigns to raise money to help protect endangered species such as the rhino

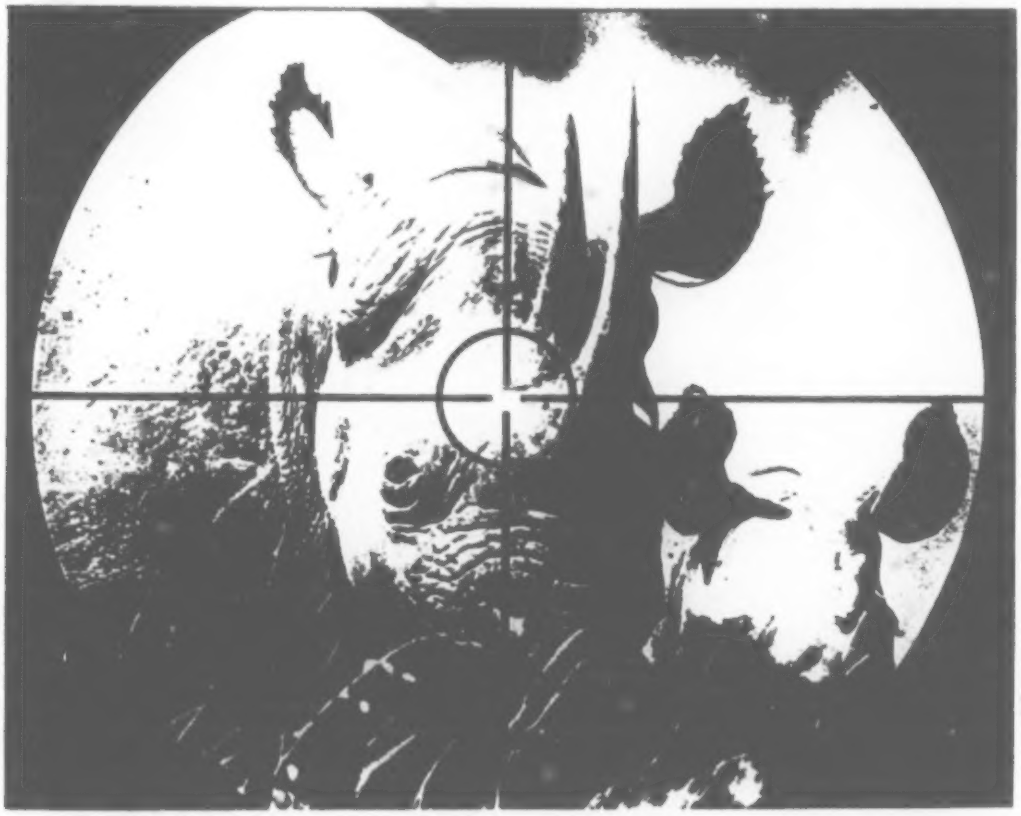
- **Breeding endangered species in protected areas, such as animal orphanages and zoos, with a view to releasing the offspring back into the wild.**

It is the responsibility for all of us to persuade our communities to realize the need to conserve and manage our wildlife for present and future generations.

A major problem in many African countries is the rapid disappearance of wildlife in both marine ecosystems, such as coral reefs, and overland ecosystems like the rangelands. When, as a result of this disappearance, a certain type of animal or bird stops living on the earth and can only be seen in pictures or heard of in stories, then we say that it is **extinct**. There are a number of animals that have become extinct. The dodo is one example; and another one is the dinosaur which became extinct millions of years ago.

Some wild animals, such as the rhino, mountain gorilla and the whale are in serious danger of extinction. These are called **threatened** species. Others have been hunted so seriously that their numbers are declining fast, although they are not yet on the way to extinction. These are called **endangered** species.

Many issues are related to loss of wildlife; Table 9.F summarizes only the main ones.



Source: WWF-UK

Table 9.F: Causes, Effects and Possible Solutions to the Loss of Wildlife

Causes of Loss of Wildlife	Effects	Possible Solutions
1. The real conflict between the needs of the local people and those of the animals due to an increase in population.	(a) Some wildlife are predator such as lions, and can cause loss of livestock and crops as in pastoral areas. (b) Other animals such as baboons and elephants can destroy crops for farmers.	Better wildlife management and conservation by setting up of protected areas - most effective defence against loss of wildlife. These include National Parks, National Reserves Conservation areas, and the biosphere reserves. They vary in number from one country to the other in the region.
2. The artificial manner in which the boundaries of protected areas are drawn up so that in time of drought for example, Wildlife can invade farms and settled areas in search of pasture and water. Also excessive protection leads to animal over-population.	When wildlife numbers in confined areas increase, overgrazing of rangeland occurs and can lead to: (a) Elimination of tree cover by the large mammals, such as elephants. This can have adverse environmental consequences when the tree cover, which protects the soil against erosion and desiccation is damaged, and (b) Acceleration of the spread of diseases such as sleeping sickness and other parasitic diseases of which some wildlife are carriers.	(a) Better wildlife management technique such as cropping the animal population in protected areas through controlled licensed hunting and game ranching such as the Wildlife Management Project for Tanzania. (b) Fencing to keep wildlife off cultivated areas and farms and/or to offer new grazing areas to other pastoral societies such as the Maasai, and karamajong. (c) Livestock dipping in safe pesticides over such areas as in the rangelands.
3. Destruction or degrading of habitat by expansion of settlement, agriculture and industrial development, and deforestation into areas previously left to wild animals.	3. Reduction of the areas where wildlife live, and restricting them to poorer habitats where they find it difficult to survive, so they migrate or die.	3. Creation of properly managed nature, protected areas recognize the need to protect wildlife and the habitat.

4. Poaching or illegal hunting	4. Killing or wounding the animals regardless of their species, age or sex, thus reducing the breeding of the survivors. This can lead to their extinction, for instance rhinos, elephants and cheetahs.	4. Education of the people to all levels, encouraging them to 'hunt' by camera or binoculars and to change their attitudes of hostility to one of care and concern for the wildlife by: (a) Visits to the protected areas to see the animals function in their natural habitats; (b) Encourage joining conservation activities such as wildlife clubs, wildlife organizations as IUCN and WWF; (c) Encourage reading wildlife publications such as 'swara',"Africana",etc (d) View wildlife films like 'Ivory Hunters', 'The Baobab - 'A portrait of a Tree', Born Free,'etc (e) Give gifts of wildlife books such as 'Born Free' and 'Serengeti shall not Die'; and (f) Write articles in newspapers on aspects of the benefit of Wildlife. 5. Support anti-poaching activities by the government such as closure of curio shops, suppression of the trade in wildlife goods like ivory, skins, claws and horns. 6. Enforcement wildlife Legistration as the Hunting Ban in 1977 in Kenya; treaties, conventions. 7. Maintaining animal orphanages, and botanical gardens. 8. Support the planing of schemes which are directed to ensuring the local people some economic benefits from National Parks Reserves such as a proportion of the entrance fees to the parks which the visitors and tourists pay.

Activity : *Conflict Between People and Wildlife*

This activity will enable the learners to explain the need to preserve wildlife and other natural resources, collect and organize information and take appropriate action where necessary on a common conservation issue in the region.

Procedure

1. Divide the class into groups and give them copies of:

   (i) *A newspaper report on the wildlife problems*

   "...It was reported that a herd of buffaloes which had eaten and trampled on a farmer's crops in his farm adjoining the national park caused him much distress and loss. The local agricultural officer suggests that the beasts be all shot to remove the menace and..."

   (ii) *The local game ranger's letter*

   "...I direct you not to cultivate the bushes around your farm as these are good habitat for wildlife and should be surrendered to the park authority. Your compensation will be worked out and..."

2. Task the students to discuss the type and cause of the conflicts between the farmer and wildlife. A short drama based on role playing may be organized to enable the students to "be in the shoes of the conflicting parties", that is, the farmer and the game ranger.

3. The students then suggest alternatives to the local game ranger's letter. They can view a film. As supportive material, you should endeavour to borrow films like 'Vanishing Breed' available from UNEP, Gigiri, P.O. Box 30552, Nairobi, Kenya or keep track of suitable programmes on Television. These programmes can be video taped.

4. The students draw up a plan of action in conservation and discuss it with a local official or the teacher/instructor.

5. The class should then take **action**. They write a letter to the local officials drawing their attention to the bad effects of the plan of action to both the wildlife and the environment. They present them with a feasible alternative solution.

Management of Natural Resources

What is management?

Management is the process of planning and implementing the plan for the utilization of resources so as to achieve a set of objectives. Sound management ensures that the resources will always be there, and continue to sustain life and the process of development. This assured continuity of resources is what is referred to as sustainability of resources.

Resource Management Methods/Approaches

There are different approaches or methods used in the management of resources. Among them are the following:

- Preservation
- Conservation
- Exploitation

Preservation

When one preserves a resource, it means that one protects it by totally abstaining from disturbing or using it.

The most common technique used to preserve natural resources is fencing areas so as to ensure that these areas are protected from people and animals outside the fence.

Conservation

This is the method of management in which people use the natural resources cautiously. Techniques usually followed in conservation include the following:

a) **Standardization (animal cropping)** is a management practice which keeps a number of animals within the carrying capacity of any given environment, so that there is no degradation of any of the resources.

b) **Harnessing** which entails the use of a resource for a desired need such as damming of rivers for irrigation and hydro-electricity generation

c) **Expansion**, that is creating more areas of the resource where none existed before.

d) **Restoration**, involves re-introducing a resource, in an area where it had previously been removed.

e) **Recycling** is a process where a used resource is processed to make it re-usable.

f) **Reclamation** and **Rehabilitation** means converting degraded land and making it useful, such as land filling and repair of eroded land and quarries, etc.

Exploitation

This process takes place when a natural resource is used to meet human/economic needs without considering or caring about future availability of the source.

Sample Lesson Plan

Time: 80 minutes *Date*:

Subject: Social Studies/Environmental Education

Topic: Natural Resources

Concepts: Resource; Environment; Natural Resources and Man-made Resources

Learning Resources: Environment Charts and Diagrams (include teacher made ones)

Objectives: By the end of this lesson, the students should be able to:

1. *Identify* and list the resources found in the school compound after exploring the school environment.
2. *Explain* the various uses of the resources after class discussion in groups.
3. *Observe*, record and report information accurately.
4. *Define* both a resource and a natural resource.
5. *Categorize* resources under the headings natural and man-made.

Introductory Activities:

1. Guide students to use their senses of sight, touch and smell when they explore the environment.
2. Divide the class into groups and let the groups choose their leaders.

Developmental Activities

1. Take the class out in their groups to observe and record all the things they see, feel and smell in the school compound.
2. Move from group to group to monitor progress.
3. Reconvene the class and call on group leaders to report their findings.
4. List the findings on the board.
5. Let the students describe the uses of the things listed on the board.
6. Guide the students to come up with the definition of a resource.
7. Let the students categorize the resources into natural and man-made.
8. Students write down the categories as a table.
9. Guide the students to define a natural resource.
10. Students write down the definitions of a resource and a natural resource.
11. Clarify and explain issues and further guide students with learning difficulties.

Concluding Activities

1. Ask questions which relate to the objectives such as,

   - What is a resource?
   - Define a natural resource?
   - Differentiate and list examples of natural and man-made resources?

2. Summarise the main points of the lesson and let students come up with generalizations

Self-Evaluation

After teaching the lesson, reflect and objectively respond to the following questions.

i) How well did I guide the groups to use their senses in exploring the school compound?

ii) How well did I evaluate groupwork, group interaction and progress?

iii) How well did I elicit varying descriptions from the students when using the chalkboard list?

iv) What could/did I do to guide students to come up with definitions of a *resource* and a *natural resource*?

v) How much was my clarification and explanation of issues based on students' responses?

vi) How did I decide which students to guide, and what did I do to help them?

vii) How will I vary groups in future and have different group leaders so as to challenge and develop all the students?

A REMINDER: METHOD, TECHNIQUE AND STRATEGY

We covered these related terms in chapters four and five.
What was the method used in this lesson? What about the strategy?
As regards the techniques which formed the strategy for the lesson they include:

1. Grouping
2. Fieldwork
3. Class discussion.
4. Reporting
5. Questions at different thinking levels

CHAPTER TEN

TECHNOLOGY AND THE ENVIRONMENT

Introduction

Human development and achievements are often the result of developing more technologies. However, the environmental problems we are facing today are, to a large extent, due to the misuse of technology. In this chapter, then, we shall selectively look at the technology employed to use some of the natural resources to meet human basic needs; its effects, as well as suggested control measures for rectifying its negative impacts.

Objectives

After reading this chapter the students should be able to:

1. Define the term technology
2. Match the resources with the technology that is used to utilize them
3. List problems created by technology
4. Suggest the solutions to the problems created by technology
5. Prepare lessons involving an application to any of the problems identified.

What is Technology?

Technology can be defined as the practical means of performing a task for human sustenance, development and comfort. Machines, tools, equipment and chemicals, form part of the technology that we use to meet our needs and wants.

Technology focuses on purpose and a given task; therefore, we often know technologies by the sectors in which they are developed. Here are some examples:

- Agricultural technology
- Industrial technology
- Computer technology
- Energy technology
- Communication technology
- Educational technology

In each of these and other technologies people invent machines, equipment, tools, and other gadgets that make work in the respective sections easier and faster.

Above all, people try to survey and prosper by making use of the resources in the environment. As populations grow, more resources are demanded in increasing quantities. Communities often try to meet the higher demand by working out and using faster means of supplying goods and services. That is why gadgets are invented. Thus the degree of advancement in the development and use of tools, machines and forms of energy, which is the **level of technology**, constantly rises. Our most important concern is that these changes in technologies affect the state of the environment. They alter the resource base, improving some and damaging many.

Technology and Resources

Activity: Effects of Technology on Resources

This activity is a brainstorming exercise in which the students name resources in the community around the school. They then describe the technologies used to harness each resource, identifying the effects of each technology and suggesting actions that need to be taken to minimize damage.

1. Ask the students to prepare outlines of a table similar to the one below, in their books while you prepare one on the chalkboard.

Table 10.A: Technology and the use of resources

RESOURCE	TECHNOLOGY USED	EFFECTS	SOLUTIONS
Rocks	**Quarrying**	**Positive**: acquisition of building materials	
		Negative: leaving open pits on ground	cover open pits

2. Let the pupils work individually for about five minutes and have them list as many resources in the community as they can.

3. Call out for, and selectively list the resources in the table on the chalkboard.

4. Continue the activity thus:

   a) Against each resource, state the type of technology employed in it.

   b) Indicate both positive and negative effects of that technology when used in the utilization of the respective resource.

   c) Give possible solutions to the negative effects which result from harnessing that technology.

Addressing Technology's Problems in the Environment

Tables 10.B to D show different examples of technologies used in the utilization of some of the natural resources. They also illustrate the positive and negative effects of the use of these technologies on the resources. Possible solutions to the problems have also been suggested.

Activity: Agricultural Technology

1. Ask the students to list the implements, machines, tools and chemicals which are used by farmers.

2. Write these on the chalk board.

3. Students should tell what each of them is used for, while you briefly write them on the board.

4. Round up by mentioning some of the things the students have not mentioned.

Project I: Use and Misuse of Technologies

Step 1 Assign students in groups a library research on the topic "use and misuse of technology". It should be completed within a week. The project report should be 4-6 pages long.

Step 2 During the research, students should be encouraged to read as widely as possible. They should be guided on how to record information accurately. They ought to have a diary to indicate the tasks that are completed each day. Students need also to compile references that they have used.

Step 3 Brainstorm to highlight the findings. Clarify issues and direct students' attention to important points. After this review, students should re-write their project reports.

Step 4 The project reports should be graded, and the best ones displayed on the bulletin board for other students to read.

Project II: Applying a Suggested Solution to a Problem

Have students plant appropriate trees in the school compound. Assign the responsibility of tending the trees to individual students. Tell them that they will have to do this for the duration of their stay in school. This guarantees the survival of the trees planted.

Evaluation

Ask the following questions:

- What technologies are used in farming?
- How are these technologies used?
- What are the effects of these technologies on land?
- Which of these are positive or negative effects?
- Indicate how you have been affected by the negative effects?
- How can negative effects be reduced or prevented?

Tables 10A to D demonstrate one way in which you could record answers from similar class discussions.

Table 10.A: Technology and land

TECHNOLOGY USED	EFFECTS	SOLUTIONS
Farming technology e.g Tractors and other heavy machinery	**Positive:** • increased yield with minimum labour **Negative:** • Compact the soil and therefore it looses its structure and thus becomes easily eroded	♦ Using appropriate farming technology with soil conservation measures. Examples: • Terracing • Gully control • Re-vegetation
Chemical e.g fertilizers and pesticides Example:- Biodegradable pesticides	**Positive:** • increased food production **Negative:** • may pollute/destroy soil and environment generally	♦ Practicing organic farming. Example: • Use of organic manures (farm yard manure, compost)
♦ Mining technology e.g Use of heavy machinery and explosives ♦ Chemicals	**Positive:** • increase output **Negative:** • leaves behind waste land • Causes air pollution • Causes erosion leading to siltation of water bodies and the destruction of aquatic life	♦ rehabilitation of wasteland Examples: • Land refill ♦ adoption and application of Anti-pollution measures
Road construction technology e.g heavy machinery	**Positive:** • improved roads **Negative:** - leaves behind waste land and open pits which fill up with water and become health hazards	♦ reclamation of wasteland Examples: • Filling up the pits and introducing vegetation cover (Trees, shrubs and grass)

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Table 10.B: Technology and water

TECHNOLOGY USED	EFFECTS	SOLUTIONS
Damming technology Example:- Use of heavy machinery	**Positive:** • modification of climate • Provision of improved nutrition • provision of recreational activities **Negative:** • displacement of people • destruction of plant and animal life • creation of breeding grounds for disease vectors e.g mosquitoes and snails	• planned resettlement schemes for people • carry out environmental impact assessments before constructing dams • proper dam management i.e • stoppage of siltation • introduction of a variety of fish species
Irrigation technology	**Positive:** • transport of water to areas of scarcity • increased food supply **Negative:** • creation of breeding grounds for disease vectors such as snails • loss of soil fertility through leaching - formation of artificial salt pans	• appropriate irrigation techniques e.g drip, prinkler and so on • re-fertilization of the soil

Table 10.C: Technology and Forests

TECHNOLOGY USED	EFFECTS	SOLUTIONS
Felling technology using heavy machinery	**Positive:** • provision of materials e.g timber, paper, medicine and so on **Negative:** • deforestation leading to alteration of the climate which will finally cause desertification and erosion • green house effect • destruction of plants and animal life.	• carry out afforestation and reforestation programmes Example: Tree planting

Table 10.D: Technology and animals

TECHNOLOGY USED	EFFECTS	SOLUTIONS
Technology like fencing, traps, fishing boats and guns	**Positive:** • control over the animals and creation of game sanctuary. **Negative:** • interferences with the migratory patterns of animals • kills animals • removes animals from their natural habitat	• use of proper fishing nets (appropriate sizes for fish to be caught) • plan fencing so that it interferes minimally with the needs of the animals

Table 10.D: Technology and industry

TECHNOLOGY USED	EFFECTS	SOLUTIONS
Industrial	**Positive**: • provision of goods and services • **Negative:** • Environmental pollution	pre-treatment of the industrial wastes to meet the the minimum recommended standards

Case Study: Energy Technologies

Introduction

There is no human activity that can take place without energy. The food that we eat is used by the body to generate energy. Besides food, there are many other ways in which we generate and use energy in the environment. However, the form of energy that we choose to generate and how we actually use it can affect the environment in many ways. In this case study, we shall examine the generation, use, advantages and disadvantages of various forms of energy. While we do this, we shall look at several technologies involved in harnessing energy resources and their environmental implications.

Objectives

By the end of this case study, the students should be able to:-

1. Define energy and state its ultimate source.
2. List the forms of energy available to their community and country.
3. Suggest advantages and disadvantages of each form of energy.
4. Make informed choices of energy technologies to use.
5. Take actions that can ensure sustainability of energy resources.

What Is Energy?

Often we hear people saying that they "have no energy" meaning that they feel tired, and they have no strength to work or even play. What, then, do we mean by energy? In simple terms, energy means **strength** or **power** which enables any person or machine to perform a task.

By now you should know the ultimate source of energy. If you don't, read about food chains and food webs in chapter one. Figure 10.1 should also help you to remember this source.

When energy is transmitted to the earth it takes various forms. At the same time, people use various technologies to tap it in different forms. Let us take an overview of some of these forms of energy.

Human power: Generated in the bodies of human beings

Animal power: Power generated by animals, such as donkeys, mules, oxen, and camels and other beasts of burden to move objects and machines

Solar power: Energy obtained directly from the sun in form of heat or light

Wind power: Ability of air in motion to move objects, and wind mills which turn other machines, such as pumps

Wood fuel: Any vegetation material used to burn and cook, such as firewood, charcoal and grasses

Water power: The force of moving water which can drive a wheel or another machine such as a pump; for example, river water and waves at sea

Hydroelectricity: Power produced by fast moving water which drives a turbine connected to a generator to produce an electric current

Geothermal power: Electricity produced by using steam from the crust of the earth to drive turbines connected to generators

Fossil fuels: Heat energy or thermal power produced by burning combustible rocks like coal and peat; fluids, that is, petroleum or oil; and gases, like natural gas, which were formed millions of years ago from formerly living animals and plants

Biogas: Combustible gases produced by bacteria from the processes of decay and digestion in an environment that is free of oxygen

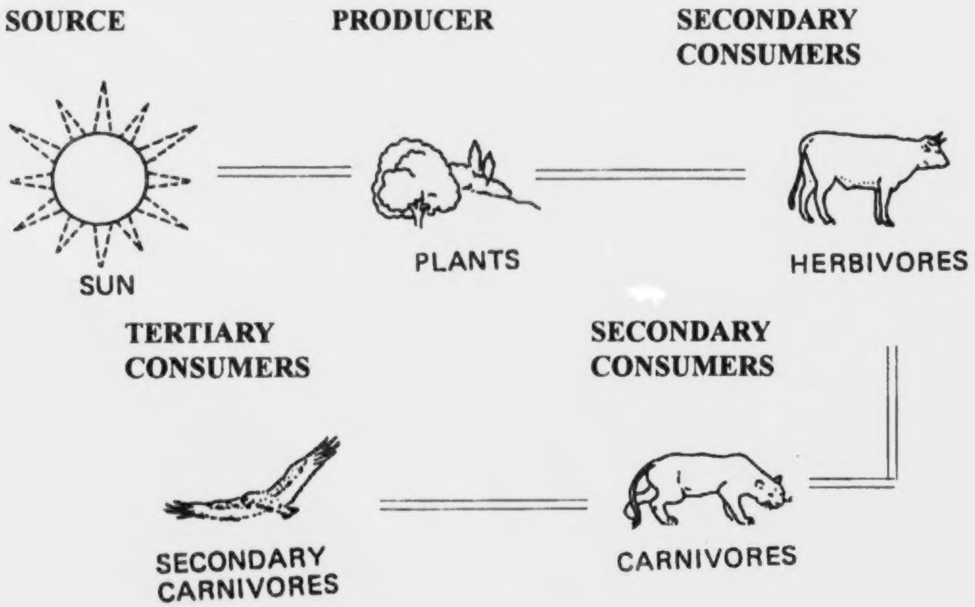

SOURCE
PRODUCER
SECONDARY CONSUMERS
SUN
PLANTS
HERBIVORES
TERTIARY CONSUMERS
SECONDARY CONSUMERS
SECONDARY CARNIVORES
CARNIVORES

Fig. 10.1: The origin and transfer of energy

Causes and Impact of the 1976-81 Energy Crisis

There are only a few countries in the world that produce oil. Up to 1973, the price of oil in the world was quite low. Then, the producer countries drastically reduced the amount of oil sold to several buying countries. The reasons for this boycott were mainly political. This cut back on oil production resulted into a shortage of oil in the world market. Most countries could not afford to buy oil at those high prices so they tried to use alternative forms of energy. However, such alternatives could not be immediately available as they had to be developed. So the shortage of energy continued as did the general rise in the price of oil. This unfortunate set of circumstances is referred to as the energy crisis. Sometimes it is called the oil crisis, because it was triggered by high oil prices.

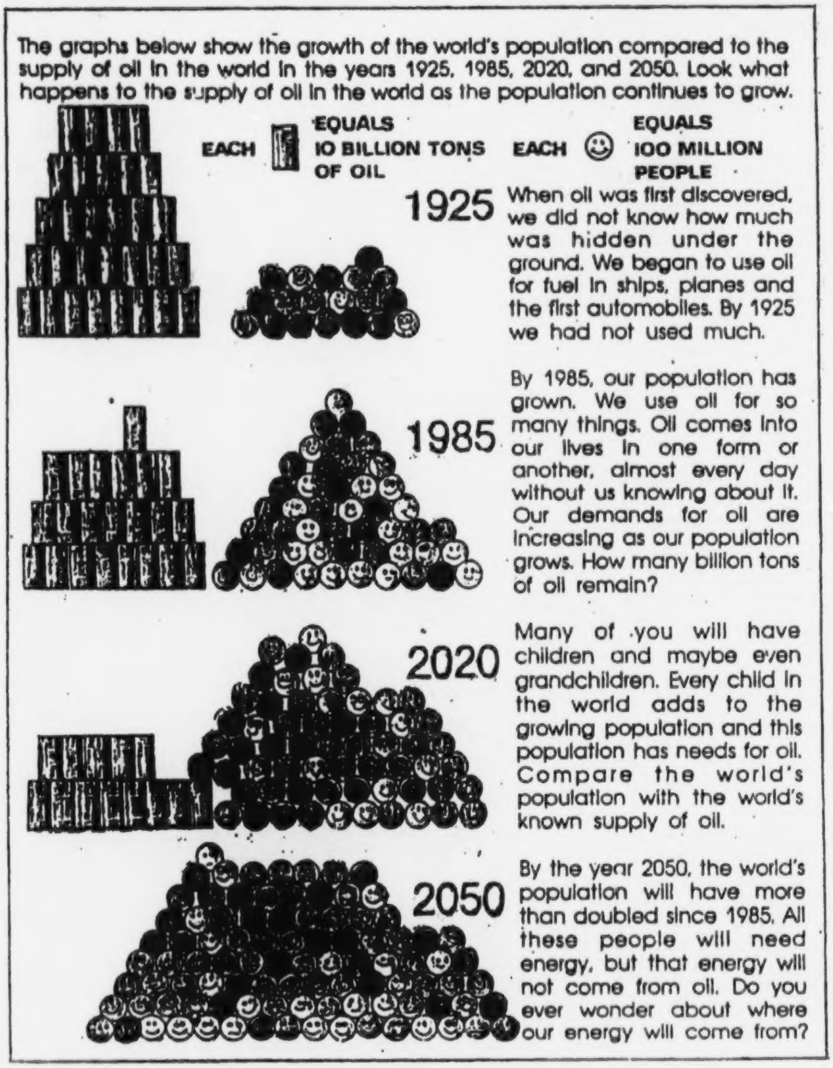
The energy crisis has led to a very rapid increase in prospecting or searching for oil and more intensive exploitation of existing deposits. The "oil rush" has been so fierce that it resulted into the world overproducing oil. Thus in 1981/82 there was a serious oil surplus on the world market. This caused prices to decline very rapidly.

The second aspect of the oil crisis is that over-exploitation and an ever increasing demand for this fuel are threatening available oil reserves. Various studies of 1979/80 and 80/81 indicate that world oil reserves may last for the next 25 to 30 years only if exploitation continued at the existing levels.

The third aspect of the crisis in its relation to population is illustrated by Figure 10.2.

In summary the energy crisis has affected our counties in a number of ways. Here are some examples.

- Countries have to pay heavily for oil imports.
- Manufactured goods imported from the industrial countries have become more expensive due to the energy crisis.
- We are earning less amounts of foreign exchange for our agricultural exports; this is because recession in industrial countries has led to a severe fall in world market prices.
- The ordinary person has to pay more for energy like kerosene and petrol; hence the high cost of living.



The graphs below show the growth of the world's population compared to the supply of oil in the world in the years 1925, 1985, 2020, and 2050. Look what happens to the supply of oil in the world as the population continues to grow.

When oil was first discovered, we did not know how much was hidden under the ground. We began to use oil for fuel in ships, planes and the first automobiles. By 1925 we had not used much.

By 1985, our population has grown. We use oil for so many things. Oil comes into our lives in one form or another, almost every day without us knowing about it. Our demands for oil are increasing as our population grows. How many billion tons of oil remain?

Many of you will have children and maybe even grandchildren. Every child in the world adds to the growing population and this population has needs for oil. Compare the world's population with the world's known supply of oil.

By the year 2050, the world's population will have more than doubled since 1985. All these people will need energy, but that energy will not come from oil. Do you ever wonder about where our energy will come from?

Fig. 10.2: The rising demand for energy in the world

Source: The Pied Crow's Environment Special Magazine, Vol. 4, No.1, CARE - Kenya

Dealing with the Energy Crisis

First we must know that there is no single simple solution. Several actions should be combined. In this region we may include among such actions, the following:

- Finding alternative energy sources
- Saving energy itself
- Conserving and improving energy sources
- Regulating population growth

Some of these actions are discusses and illustrated in the activities that follow now.

Activity: *Forms of Energy Used in My Home*

In this activity the students will identify the forms of energy used in their homes. They will also find out why the respective choices of energy forms were made by the household. A systematic way to do this would be to prepare a table similar to the one below and to complete it appropriately.

Table 10.E: Record of forms of energy used in my home

Form of Energy	Tasks for which it is used	Advantages of using it	Disadvantages of using it
1. Human	a) Cleaning the home b) Washing Clothes, and c) Cultivating	a) Skillful technical ability b) Lack of money to buy machines and tractors, and c) Labour is available	a) Slow and tiring, and b) Labour costs change with seasons.
2..............	....	....	....

Forms of Energy

Cheaper and renewable forms of energy should be used instead of oil and coal. The main ones that can be used in this region are:

- Biogas
- Wind power
- Solar energy
- Hydro-electricity
- Geothermal power

It should be noted that already governments have taken steps to deal with the energy crisis. These include:-

- Radio campaigns to promote energy conservation, such as using energy saving charcoal stoves
- Reduction of oil imports
- Rationing oil

- Limiting the use of private vehicles
- Encouraging people to use vehicles that consume little oil

Activity: *Your Own Biogas Plant*

This activity is of immense benefit in a school situation and to the community. It teaches practical, low cost technological skills, and it encourages community co-operation. Study figure 10.3 as you follow the activity.

Why Build One?

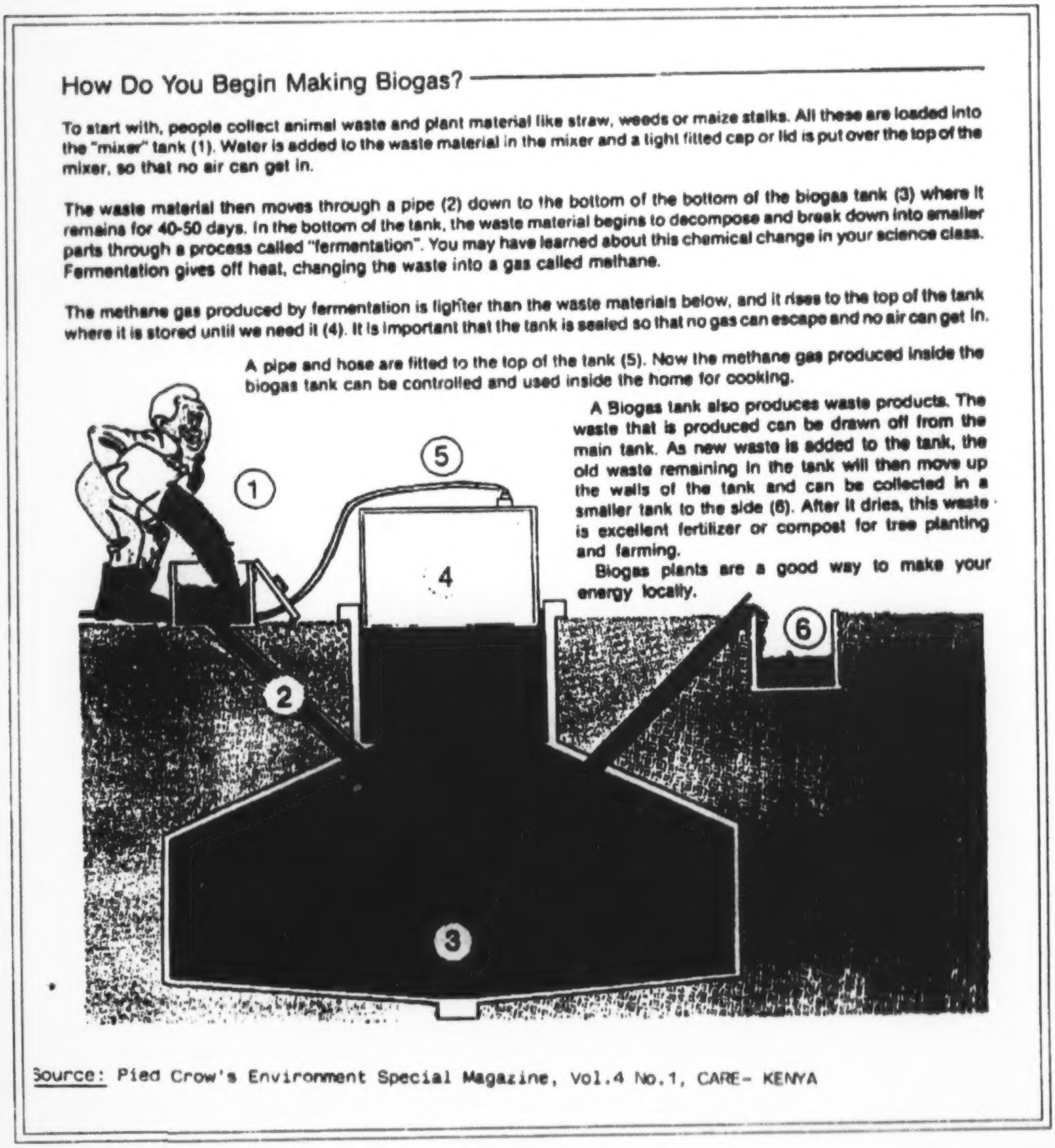
Here are reasons why you can, and should, construct a biogas unit at your home, school or community.

1. Comparatively, it costs little to construct the unit if you consider the immense benefits of biogas and manure. The materials required namely, cement, sand and stone would cost $100 to $150 in this region.
2. The materials are locally available and demand no foreign exchange.
3. The 'raw materials' required, like vegetative waste and animal dung are available and need not be bought.
4. Work like digging and construction can easily be done on the basis of self-help among neighbors or schoolmates, through co-operative efforts.
5. Slurry or manure mixed with water is made without any further cost.

Saving Energy

The idea of *saving*, is using only what is necessary and keeping the remainder until it is required. This is the way we should use all forms of energy. Here are some practical energy saving hints.

- Do not light fires unnecessarily at home.
- Put out fires in the kitchen whenever cooking ends.
- Use an energy saving "jiko" or charcoal stove (Fig.10.4).
- Switch off electric lamps or put out lantern lamps in rooms that are not being used.
- Motorists should switch off motor vehicle engines when the vehicles are stationary.



How Do You Begin Making Biogas?

To start with, people collect animal waste and plant material like straw, weeds or maize stalks. All these are loaded into the "mixer" tank (1). Water is added to the waste material in the mixer and a tight fitted cap or lid is put over the top of the mixer, so that no air can get in.

The waste material then moves through a pipe (2) down to the bottom of the bottom of the biogas tank (3) where it remains for 40-50 days. In the bottom of the tank, the waste material begins to decompose and break down into smaller parts through a process called "fermentation". You may have learned about this chemical change in your science class. Fermentation gives off heat, changing the waste into a gas called methane.

The methane gas produced by fermentation is lighter than the waste materials below, and it rises to the top of the tank where it is stored until we need it (4). It is important that the tank is sealed so that no gas can escape and no air can get in.

A pipe and hose are fitted to the top of the tank (5). Now the methane gas produced inside the biogas tank can be controlled and used inside the home for cooking.

A Biogas tank also produces waste products. The waste that is produced can be drawn off from the main tank. As new waste is added to the tank, the old waste remaining in the tank will then move up the walls of the tank and can be collected in a smaller tank to the side (6). After it dries, this waste is excellent fertilizer or compost for tree planting and farming.

Biogas plants are a good way to make your energy locally.

Source: Pied Crow's Environment Special Magazine, Vol.4 No.1, CARE- KENYA

Fig 10.3: How to build biogas plant

Conserving and Improving Energy Sources

Most energy in this region comes from wood. It is in the form of firewood and charcoal. Trees are therefore our most important single source of energy. Conservation and improvement of energy sources must thus begin with conserving and increasing the number of trees in our villages. This is the message in the comic strips that follow.

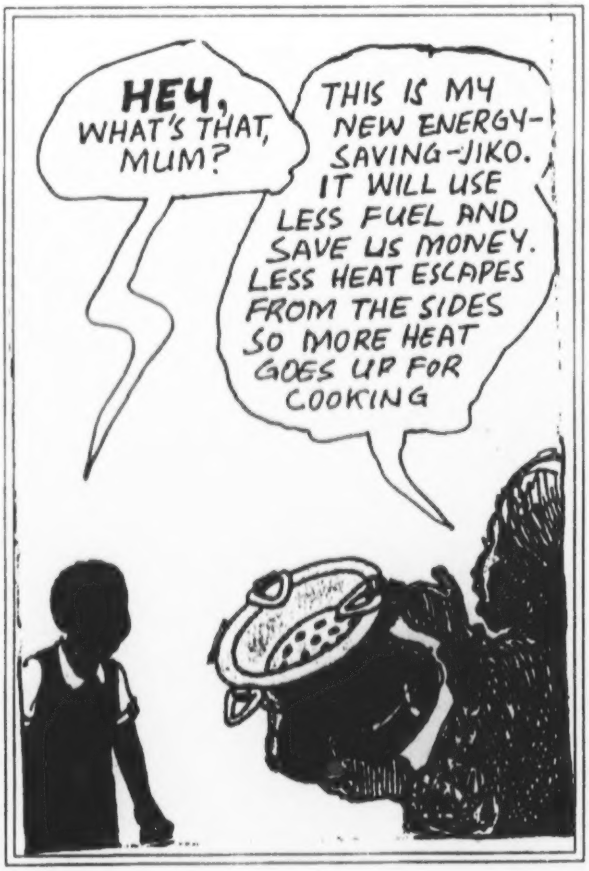
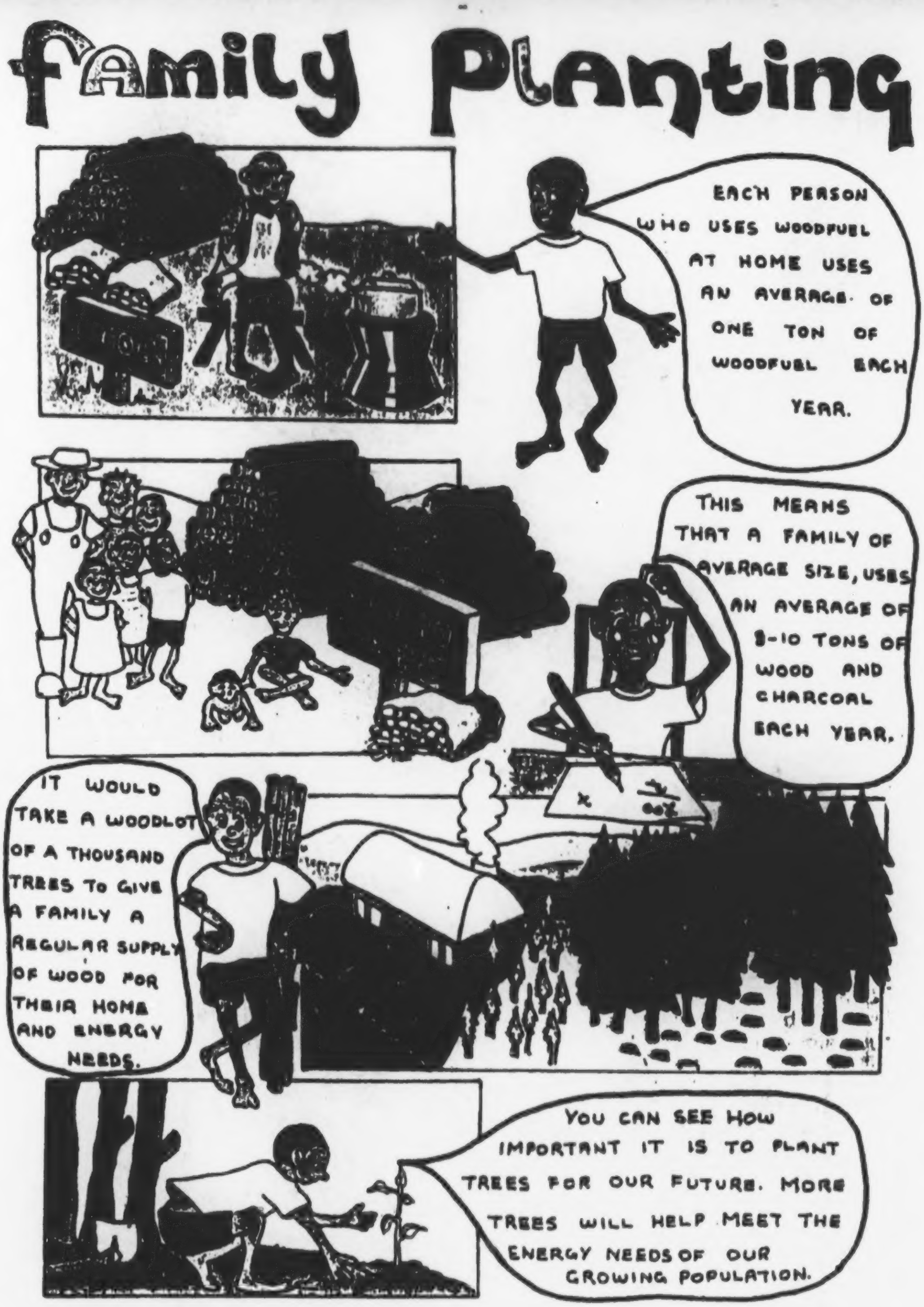

HEY, WHAT'S THAT, MUM?
THIS IS MY NEW ENERGY-SAVING-JIKO. IT WILL USE LESS FUEL AND SAVE US MONEY. LESS HEAT ESCAPES FROM THE SIDES SO MORE HEAT GOES UP FOR COOKING

Fig. 10.4: An Energy-saving charcoal stove (jiko)



Family Planting
EACH PERSON WHO USES WOODFUEL AT HOME USES AN AVERAGE OF ONE TON OF WOODFUEL EACH YEAR.
THIS MEANS THAT A FAMILY OF AVERAGE SIZE, USES AN AVERAGE OF 8-10 TONS OF WOOD AND CHARCOAL EACH YEAR.
IT WOULD TAKE A WOODLOT OF A THOUSAND TREES TO GIVE A FAMILY A REGULAR SUPPLY OF WOOD FOR THEIR HOME AND ENERGY NEEDS.
YOU CAN SEE HOW IMPORTANT IT IS TO PLANT TREES FOR OUR FUTURE. MORE TREES WILL HELP MEET THE ENERGY NEEDS OF OUR GROWING POPULATION.

Source: Pied Crow Magazine; Op. cit

Fig.10.5: How to meet family wood fuel

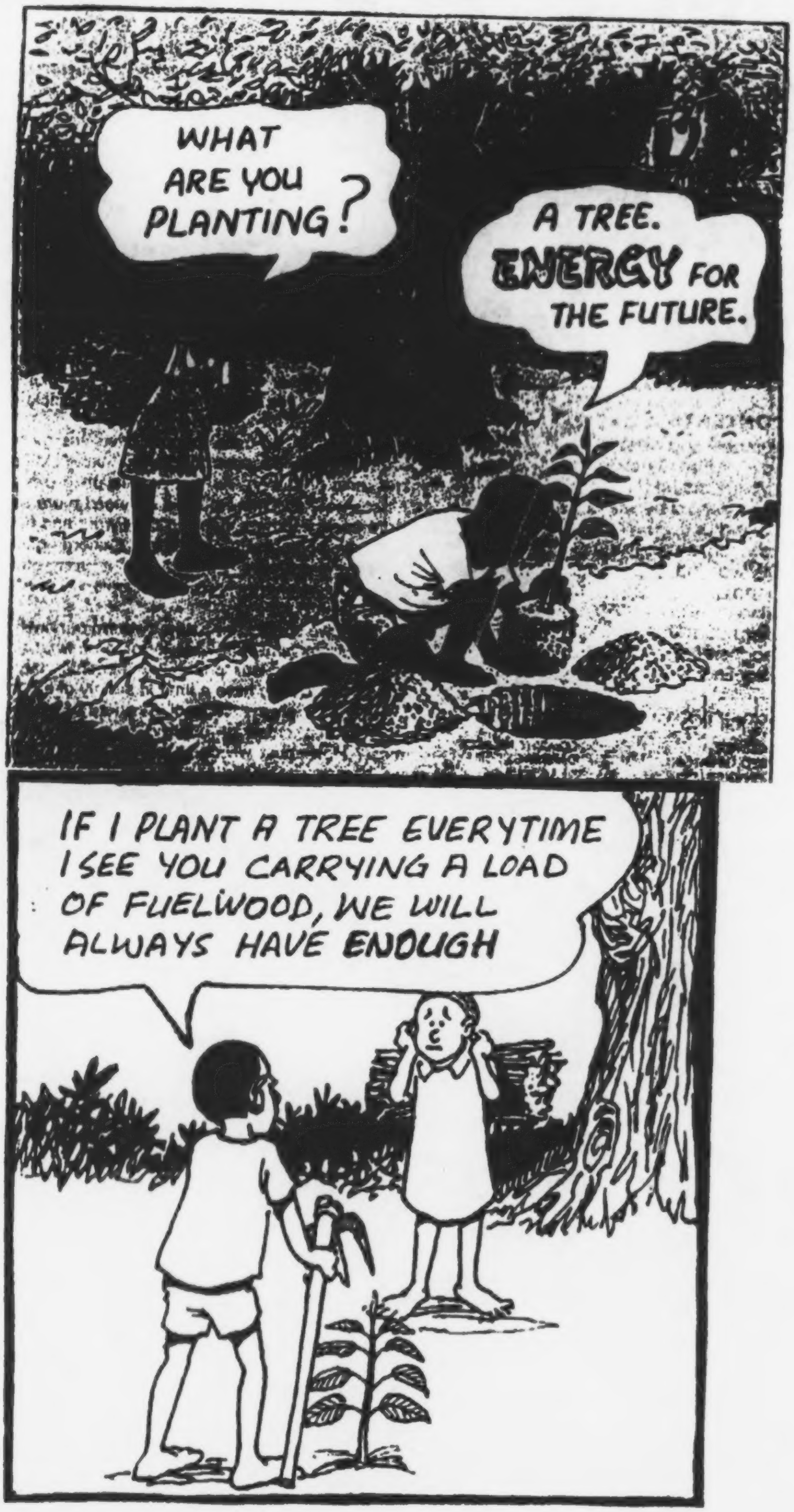
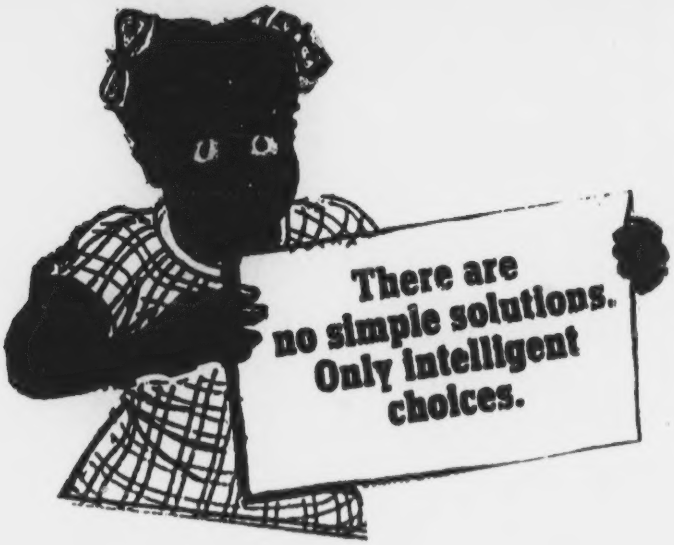

WHAT ARE YOU PLANTING?
A TREE. ENERGY FOR THE FUTURE.
IF I PLANT A TREE EVERYTIME I SEE YOU CARRYING A LOAD OF FUELWOOD, WE WILL ALWAYS HAVE ENOUGH

Fig. 10.6: How to ensure future family wood fuel energy demand


There are no simple solutions. Only intelligent choices.

Source: Mazingira Mazagine

Fig. 10.7: A word of caution when dealing with population issues

Sample Lesson Plan

Time: 80 minutes *Date*:

Subject: Social Studies/Science/Agriculture

Topic: Farming Technology

Concept: Resource, technology, farming

Learning Resources: Library, situation handouts, diagrams

Objective: At the end of the lesson, the students should be able to:

1. Define the terms resource, technology and farming, after a brainstorming exercise.
2. Identify the technologies used by a farmer after reading a text on technology.
3. Explain the uses of the technology utilised in farming after class discussion.
4. Write down the effects of technology on land.

Introduction

Brainstorm on technology, resources and farming in the country. The students should come up with correct responses. List the responses on the three concepts of resource, technology and farming. Prompt students to come up with the definition of the terms. Write suggested definitions on the board. Refine the definitions and have students note them in their books.

Developmental Activities

Procedures

1. Divide the class into groups. Each group should identify the technology used in farming in their locality.
2. Have them list the advantages and disadvantages of each technology.
3. Students should suggest ways of dealing with the disadvantages.
4. Group leaders should report their findings.
5. Summarize reports on the board.
6. Hold open class discussion to enrich and consolidate the lesson.

Conclusion

1. Ask the students to define:

- Resource
- Technology
- Farming.

2. What farming technologies are used by farmers in your locality?
3. How is the technology useful?
4. Name some effects of the use of the technologies.
5. What solutions can you suggest to deal with the negative effects of the technologies?

Self-evaluations

Indicate areas where you succeeded in realizing your objectives as well as areas of weaknesses. Suggestions should be made on how weaknesses can be dealt with either through remedial activities or in subsequent lessons. Your record of work should reflect this information.

Strategy Used

In this lesson your strategy involved the combined use of the following teaching techniques.

1. Brainstorming
2. Class discussion
3. Questioning at different thinking levels
4. Recording and reporting.

"The earth is like a tiny oasis in the vastness of space"
James A Lovell Jr, American astronault, Apollo 8, 1968

ONLY ONE EARTH
CARE AND SHARE